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# BACKYARD PEST MANAGEMENT IN ALBERTA

**DISEASES  
INSECTS  
WEEDS**

**INSIDE:**

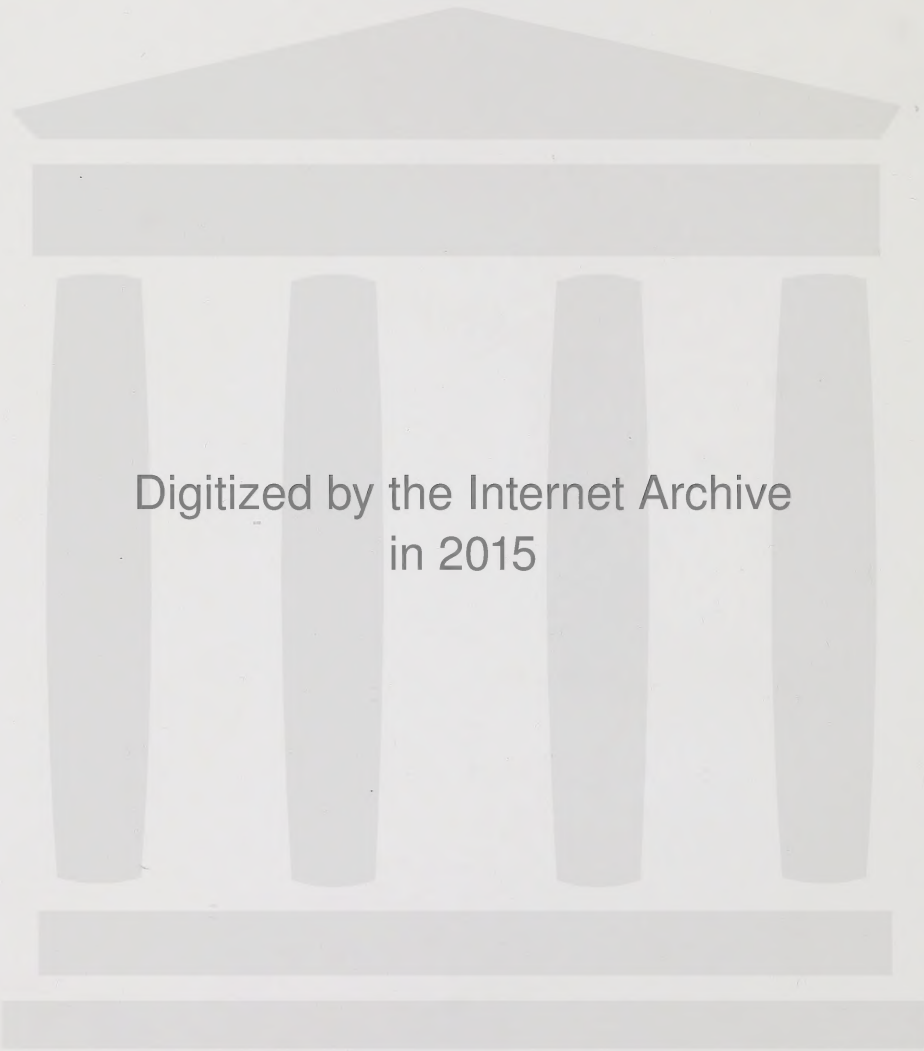
ANSWERS TO OVER  
150 COMMON  
**PEST PROBLEMS**

ALTERNATIVES TO  
**PESTICIDES**

PROPER USE OF PESTICIDES,  
**SAFETY FIRST!**



**PRACTICAL, COST-EFFECTIVE SOLUTIONS TO PEST-RELATED PROBLEMS**



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# Backyard

## PEST MANAGEMENT

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#### Contributors:

##### Insects

Mike Dolinski  
Jim Jones

##### Weed Control

Shafteek Ali  
Denise Maurice

##### Diseases

Ieuan Evans  
Gail Rankin  
Steve Slopek

##### Vertebrate Pests

Bob Acom  
Mike Dorrance

##### Safe Use of Pesticides

Neil Wandler

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**Editor:** Gerard Vaillancourt, P.Ag.

**Graphic Designer:** John Gillmore

**Typographer:** Sherrill Strauss

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# Introduction

**T**his publication provides homeowners with basic information about management of insects, weeds, plant diseases and vertebrate pests commonly found in the backyard. The information will help you identify and select non-chemical and chemical approaches to solving pest problems. In many cases it is unnecessary to take action because the pests do not cause significant damage. In other cases, simply spraying a tree with water, pruning a branch or digging up a weed will reduce or eliminate the problem. Your approach to pest management will depend on your tolerance to the pest, its damage in whatever form, and your basic philosophy about handling pest problems.

There is no right or wrong approach to backyard pest management. However, there is a legal aspect, if you use a pesticide to solve a problem, you must use it according to label directions.

## Pesticide Protective Clothing

### Hats

Wear a washable plastic hat with a plastic sweatband and a wide brim.

### Gloves

Unlined, nitrile or neoprene (cuff gloves and wear sleeves over gloves)

### Boots

Neoprene overboots or high rubber boots (wear pants outside boots).

### Long Sleeved Shirt and Pants

Closed at the neck and cuffs.

### Note:

Clothing worn when spraying pesticides should be washed in hot water with strong detergent after every use (wash separately from other clothing).



## Proper Use of Pesticides Safety First!

### Follow these safety tips:

- Identify the pest problem. Use a pesticide that lists both the pest and the plant on the label. Use only those pesticides marked "Domestic" in and around the home.
- Carefully read and follow label directions. When applying pesticides to vegetables, berries and fruits, pay particular attention to mixing directions and the wait period before harvesting.
- Mix pesticides outdoors and stand upwind. Do not spray on windy days. Do not inhale pesticides. Always use the safety equipment listed on the label. Never smoke, eat or drink when handling pesticides.
- Use different sprayers for insecticides and herbicides or wash the sprayer thoroughly, especially after using herbicides. Traces of herbicide can kill sensitive plants.
- Keep your skin covered. Change your clothes after you handle pesticides. Wash your clothes in hot soapy water, separate from other clothing. Wash your hands and face thoroughly after using pesticides. Do not allow children or pets to play on or in the treated area for 24 hours.
- Do not allow pesticides to drift onto your neighbors' ornamentals or vegetables. To protect pollinating insects, spray late in the evening when bees are inactive and try to avoid spraying trees and shrubs when they are in bloom.

# Insect Pests

## INTRODUCTION

### Approaches to Pest Management

#### Cultural

##### Trees and Shrubs

Most deciduous trees and shrubs can withstand substantial defoliation, especially late in the growing season. Coniferous trees cannot withstand significant defoliation, even over a number of years.

Insect pests and infested leaves can be picked-off and destroyed. Pests like caterpillars, leaf rollers, wooly-bears and galls can be dealt with in this fashion when infestations are low. Insects such as wooly bears, which develop late in the fall, rarely reach damaging levels and can be left to enjoy your trees. Additionally, actions such as scraping dormant forest tent caterpillar egg bands off trees and shrubs in winter will reduce your pest problems.

Perhaps the best way to control insects is with a garden hose. Spraying trees and shrubs thoroughly and regularly with a strong spray of water from a garden hose will dislodge and kill small caterpillar larvae, aphids, spider mites, pear slugs, and other pests which may be on the tree. Although pure soap can be added to the spray using a garden hose applicator, the spray pressure alone is usually adequate to control the problem. If pure household soap is used, the plants should be washed about 15 minutes after the soap application to reduce toxicity to plants and avoid white soap deposits on the foliage. This process does not apply to commercially available "Insecticidal Soaps" which should not be washed-off treated plants.

##### Vegetable and Flowers

Insects such as Colorado potato beetles can be picked-off plants. Cutworms can be prevented from attacking transplants by sinking large tin cans with both ends removed down into the soil around plants to act as barriers to the cutworms. In seeded crops, dig-up and destroy the cutworms, which can be found in the soil at the base of recently killed plants. This prevents further damage by the cutworms. Tar paper discs can be placed tightly around the base of cole crops to discourage root maggot flies from laying eggs on the soil around the plants. Floating mulches (row cover) can also be used to protect plants from insect attack, provided the insects don't emerge from the soil under the mulch. This means you must move your cruciferous plants to an area that didn't have cruciferous plants in the past year.

A regular pressure spray using your garden hose will dislodge and kill many foliage feeding insects. Keep plants well spaced and foliage off the ground to reduce damage by slugs. In addition, place boards between rows to provide

artificial hiding places for slugs, then destroy the slugs that take shelter under the boards during the day. Bowls of beer can be sunk into the soil so they are flush with the soil surface. Slugs are attracted to the beer and drown when they fall into the bowl.

#### Biological Control

Although cultural approaches to best management could in a sense be considered biological, we consider biologicals as living organisms or the products of living organisms. Some people buy lady bugs, praying mantids and other parasitic and predatory insects to control backyard insect pests. They may have some effect, but they frequently leave the yard, especially if their food supply is poor. The most available biological is a bacterium called *Bacillus thuringiensis*. These bacteria and the crystals they form, if eaten by leaf-feeding (caterpillar-like) insects while feeding, provide good control. Additionally, because these bacteria selectively kill larvae of butterflies and moths, treatment with *B. thuringiensis* does not affect beneficial insects.

#### Natural Insecticides

Some people feel more comfortable using natural insecticides, which are produced from plants or the remains of fossilized sea creatures. They are tested and registered in the same way as synthetic insecticides. Just because these products are considered "natural" doesn't mean you can be careless and not follow label directions for safety precautions and wait periods to harvest.

The most readily available of these natural insecticides are diatomaceous earth, pyrethrum, and rotenone. Diatomaceous earth is made from ground up diatoms. The minute crystals in this earth scratch the insect's body and digestive system resulting in death. Pyrethrum and rotenone are active insecticidal ingredient extracted from green plants.

#### Synthetic Insecticides

These are insecticides that were developed to kill insects. They are tested and registered, just like natural insecticides to ensure safety to the applicator and environment. Virtually all "Domestic" insecticides have been proven in use around the world for 10 or more years, in most cases 20 or more years. Synthetic insecticides kill insects, as do natural insecticides, primarily by contact or when eaten, or a combination of both. Some are termed systemic, which means the insecticide is absorbed into the plant and moved throughout the plant internally.

These insecticides break down in or on plants at different rates, therefore there is always a wait period to harvest for

insecticides used on crops intended for food or animal feed. Some insecticides can only be applied to non-food crops.

## Buying Insecticides

When you look at the array of insecticides on the shelves at most retail outlets, it can be difficult to select a product. The names can be endless. In reality, most products for the backyard gardener contain one or a combination of only 8 to 10 different active ingredients. Compare prices of products with the same active ingredient. If the amount of active ingredient is the same, buying the cheaper product may save money. Before buying an insecticide ask yourself the following:

- Do I need to spray with an insecticide or can I use other approaches to solve the problem?
- Do I already have a product that is labelled to control the insect(s) on the plant(s) being attacked? Use the products you have if they are suitable. This will help to reduce your stockpiles.
- Do I need a very specific product to solve the problem or can I buy an insecticide that will solve a lot of the insect problems that I can expect? Base your decision on the plants you grow and past experience.
- Do I need an insecticide that can be applied to edible and ornamental plants or just one or the other? Not all insecticides can be applied to edible fruits and vegetables.

## Common Domestic Insecticides

| Active Ingredient             | Product Name*                     |
|-------------------------------|-----------------------------------|
| <i>Bacillus thuringiensis</i> | Thuricide, Biological Insecticide |
| carbaryl                      | Sevin                             |
| chlorpyrifos                  | Dursban, Bugban, Banisect         |
| diatomaceous earth            | Insectigone, Slug and Snail       |
| diazinon                      | Diazinon, Maggot Granules         |
| dimeethoate                   | Cygon, Lagon                      |
| ethion                        | Onion Maggot Granules             |
| insecticidal soap             | Several                           |
| malathion                     | Malathion                         |
| metaldehyde                   | Slug Bait, Slug Pellets           |
| methoxychlor                  | Methoxychlor                      |
| permethrin                    | Ambush, Bug Kill                  |
| pyrethrum                     | Added to many products            |
| rotenone                      | Rotenone, Deritox Dust            |

This list includes the majority but not all insecticides available. Mixtures of insecticides or insecticides and fungicides are not included. Check for the active ingredient on the label, many different products are available, but may contain the same guaranteed active ingredient.

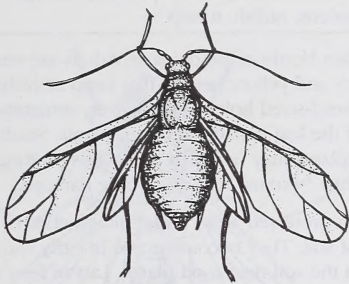
**Always follow label directions.**

# Insect Pests

## OF VEGETABLES

### Aphids

Crucifers, dill, potato, other garden plants



#### Injurious Stages and Damage

Aphids are small, pear-shaped, soft-bodied insects often found in colonies. Adults may be winged or wingless; nymphs are wingless. Most species are pale green but some are yellow, brown, black or pink. Both adults and nymphs injure plants by sucking sap, causing leaf distortion and reduced growth. Some transmit diseases such as potato leaf roll.

#### Life History

Most species overwinter as eggs on the stems of a perennial plant. The eggs hatch in the spring and after one or two generations, winged migrants fly to summer host crops. Adults produce living young continuously during the summer without mating.

Population growth is usually rapid. Sexual forms of aphids, produced in the fall, mate and lay the overwintering eggs.

#### Cultural Control

Hose down plants frequently with forceful sprays of water from a garden hose to keep populations down.

#### Chemical Control

Apply diazinon, dimethoate, insecticidal soap, malathion, pyrethrins or rotenone dust as necessary.

### Colorado Potato Beetle

Potato, tomato, eggplant



#### Injurious Stages and Damage

Both adults and larvae eat the leaves of host plants. Adults are rounded, hard-shelled beetles, 12 mm long, with alternating black and yellow stripes running lengthways on the back. Larvae are soft, hump-backed and brick-red, with two rows of black spots on each side.

#### Life History

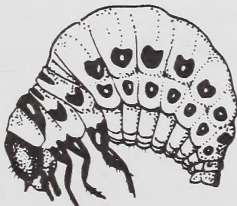
Adult beetles pass the winter deep below the soil surface. They emerge about the same time as the potato sprouts leaf out. Females lay batches of orange/yellow eggs on the underside of leaves. Larvae hatch and feed voraciously, completing development in about two to four weeks. They pupate in the soil and new adults emerge about a week later. Heavy snow fall will increase winter survival of beetles.

#### Cultural Control

Clean up potato culls. Hand-pick adults if they are few in number. Be sure to control wild tomato weeds in your vegetable garden because these are the preferred host of the beetle.

#### Chemical Control

Apply carbaryl, diazinon, malathion, methoxychlor, permethrin or rotenone as a foliar treatment when beetles are first observed. Repeat as necessary to control both adults and larvae.



## Cruciferous Flea Beetles

Cabbage, broccoli, cauliflower, Brussel sprouts, rutabaga, kohlrabi, Chinese greens, radish, turnip



### Injurious Stages and Damage

Several species of flea beetle cause damage. Adults are very small, black or black and yellow beetles that jump actively like fleas. They eat pinhead-sized holes in the leaves, sometimes destroying much of the leaf surface of young plants. Small seedlings and transplants may be killed if attack is prolonged. Larvae are small white "worms" that cause little damage.

### Life History

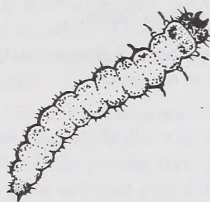
Adults overwinter in protected areas under plant debris or in the top 2 to 5 cm of soil. They become active in early spring. Females lay eggs in the soil near food plants. Larvae feed on root hairs for three to four weeks before pupating. The adults emerge and feed until freeze-up. There is only one generation a year of most species.

### Cultural Control

Control cruciferous weeds such as stinkweed, shepherd's-purse and wild mustard. Clean up garden refuse. Keep young plants well watered so they can outgrow damage.

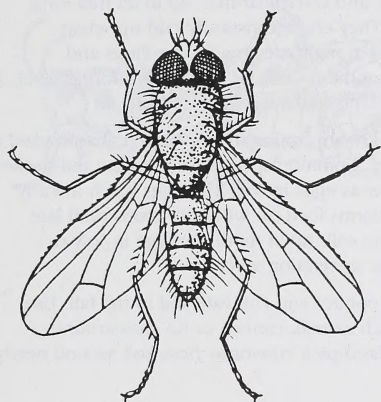
### Chemical Control

Apply carbaryl, diazinon, malathion, methoxychlor, permethrin or rotenone as a foliar treatment. Repeat as necessary.



## Cruciferous Root Maggots

Cabbage, broccoli, cauliflower, Brussel sprouts, rutabaga, kohlrabi, Chinese greens, radish, turnip, other crucifers



### Injurious Stages and Damage

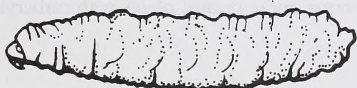
Roots are grooved or tunnelled by small, white, legless maggots. Injury allows entry of root rot organisms. Damaged plants appear stressed and outer leaves may yellow. If severely damaged, plants may wilt and die.

### Life History

Root maggots overwinter as brown pupae in the soil. Greyish flies resembling houseflies emerge in mid-May to July and females lay white eggs on the soil at the base of plant stems. They prefer to lay eggs when the soil surface is moist. Newly hatched maggots chew seedling rootlets or bore into larger roots. After about one month, mature maggots pupate and give rise to a second generation of flies in early to mid-August. The maggots cause further damage to late-harvested root crops like rutabaga. In Brussel sprouts the root maggots will often be found inside the sprouts.

### Cultural Control

Remove all cruciferous weeds such as stinkweed and shepherd's-purse from the garden. Aluminum or tar paper 15 cm diameter discs give some protection to non-root crops when placed around stems at soil level. Floating mulches will protect crops provided the crop is planted in an area where cruciferous crops have not been planted for at least a year.



### Chemical Control

Apply one of the following:

- Chlorpyrifos granular as a preplant, broadcast treatment, use diazinon EC if further treatments are required, or
- Diazinon granular in furrow at seeding or with transplants. For seeded crops, repeat two weeks after thinning as a row-top application, or
- Diazinon EC as a drench at seedling emergence or with transplants. Repeat at 7 to 10 day intervals until end of June and again from late July to mid-August for root crops.

## Cutworms

All garden plants

### Injurious Stages and Damage

Several species of cutworm damage plants. They are soil-dwelling, fleshy and caterpillar-like, up to 25 mm long when fully grown. They characteristically curl up when disturbed. Most feed at night, destroying seedlings and transplants by cutting them off at or just below ground level. A few species climb plants and eat foliage or fruit.



### Life History

Adults are the well-known "miller moths" which are attracted to lights in midsummer. Common species, such as the red-backed cutworm, overwinter as eggs in soil. The eggs hatch in early spring and the cutworms feed on weeds or crops until late June, pupating in the soil. Adult moths emerge in July or August. There is one generation a year.

### Cultural Control

Keep weeds under control and cultivate soil in the fall. Use physical barriers such as milk cartons or tin cans around individual plants. Hand-pick cutworms from soil around newly damaged plants.

### Chemical Control

Apply either:

- Chlorpyrifos as a pre-plant soil treatment, or
- Diazinon granular in furrow or around transplants.

For climbing cutworms, spray or dust plants with carbaryl.

## European Corn Borer, Corn Earworm

Sweet corn, tomato

### Injurious Stages and Damage

The corn earworm feeds on the developing silk and corn kernels and occasionally bores into tomatoes. It is a large (3.8 to 5 cm) green, brown or pink wormlike caterpillar. The European corn borer is smaller (about 2.5 cm at maturity) and light brown to pink. Just after hatching, it feeds briefly on leaves then bores into the stalk or ears to feed on the cob and kernels.



### Life History

Corn earworm infestations result from moths that are blown in from the United States in early summer. They are usually confined to southern Alberta. Eggs are laid singly on the silk. Corn borer larvae overwinter in the base of infested stalks and pupate in the spring. Adult moths are brown with yellow markings. European corn borer is only found southern Alberta.

### Cultural Control

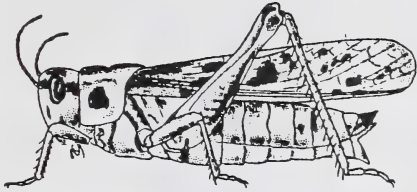
Destroy infested ears. Remove all crop refuse in the fall.

### Chemical Control

For European corn borer, treat with carbaryl, permethrin or rotenone when egg masses or feeding damage on leaves is noticed, usually late July. Repeat in seven days. Corn earworm infestations are difficult to predict. Dust the developing silks with carbaryl if eggs are observed.

## Grasshoppers

All garden crops



### Injurious Stages and Damage

Adults and nymphs of several species chew all green plant material. Adults of most species are winged; nymphs are wingless.

### Life History

Most important species overwinter as eggs in pods in the soil. They hatch in early spring and young hoppers feed for two to four weeks before the final molt to the adult stage. Adult females begin egg-laying in late July. Serious outbreaks may occur after two or three years of hot, dry weather and good snow cover.

### Cultural Control

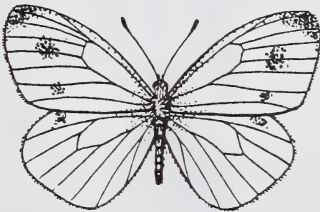
Cultivate garden and weedy areas in the fall to discourage egg laying.

### Chemical Control

Apply carbaryl, dimethoate or malathion as a spray to control young hoppers before they become egg-laying adults. Wire netting barriers may be the only protection against very severe infestations.

## Imported Cabbageworm, Diamondback Moth

Broccoli, cabbage, cauliflower, other crucifers



Cabbage Butterfly



### Injurious Stages and Damage

These caterpillars chew ragged holes in the foliage. Imported cabbageworms may also bore into heads and contaminate edible portions with their droppings. The cabbageworm grows into a velvety green, 20 mm long caterpillar with a faint gold line down the back. Diamondback larvae are pale green, much smaller (10 mm), and wriggle quickly when disturbed.

### Life History

Cabbage worms overwinter above ground as butterflies. The white cabbage butterfly emerges in spring and is joined by waves of migrants from the south. Eggs are laid singly on leaf undersides. Diamondback moths migrate from the south every spring and produce several generations each year. The adult is a small brownish moth, which usually goes unnoticed.

### Cultural Control

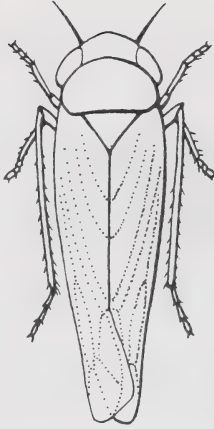
Hand-pick when the number of larvae is small.

### Biological Control

Apply *Bacillus thuringiensis* as a foliar spray.

### Chemical Control

Apply carbaryl, diazinon, malathion, methoxychlor, permethrin or rotenone as necessary.



## Leafhoppers Carrot, lettuce, celery, potato

**Injurious Stages and Damage** Leafhoppers are small, pale yellow insects that can jump and fly. They suck sap but, unless numerous, cause minimal damage. Some, however, carry and transmit aster yellows mycoplasma, which causes stunted, distorted and yellowed plants.

**Life History** Leafhoppers overwinter as eggs or are blown in from the west or south. Cereals are the preferred host, but many vegetables and weeds are also damaged. Eggs are inserted into leaf tissue. There may be two or more generations a year. Leafhoppers are primarily a pest in central and southern Alberta.

**Cultural Control** Immediately rogue out all plants showing symptoms of aster yellows. Control weeds. Use certified seed potatoes.

**Chemical Control** Apply a spray of malathion, methoxychlor, permethrin or rotenone as necessary.



## Onion Maggot Onion, chive

**Injurious Stages and Damage** Bulbs are tunnelled at their base by white, legless maggots similar to cruciferous root maggots. Rot organisms may compound damage. Attacked plants appear stressed and may wilt.

**Life History** Adult flies are a greyish color. The life cycle is similar to the cruciferous root maggot. Infestations tend to be heaviest in irrigated areas.

**Cultural Control** Destroy infested plants and remove crop residue in the fall. Use older plants, which flies prefer, as a trap crop.

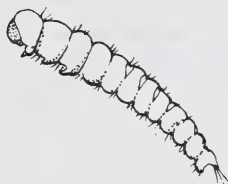
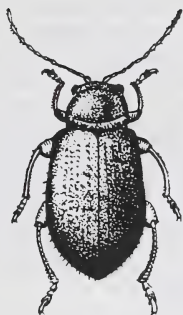
**Chemical Control** Apply one of the following:

- Chlorpyrifos granular as a preplant, soil-broadcast treatment, or
- Diazinon or ethion granular in furrow at planting, or
- Diazinon EC as a foliar spray if adults are numerous in late spring.



## Potato Flea Beetle, Tuber Flea Beetle

Potato, tomato, eggplant



### Injurious Stages and Damage

Both tuber flea beetle and potato flea beetle are now present in Alberta. They resemble cruciferous flea beetles and cause similar leaf damage. Damage by young Colorado potato beetle larvae may resemble or mask the shot-holes produced by flea beetles. Tuber flea beetle larvae, in particular, feed on potato tubers, producing surface tracks and shallow tunnels which fill with corky material rendering the potato useless.

### Summary of Life History

The life history of these beetles is similar to that of cruciferous flea beetles. There is probably only one generation a year under Alberta conditions. Netted gem (Russet Burbank) potatoes are very susceptible to damage.

### Cultural Control

Remove garden residues where the beetles overwinter.

### Chemical Control

When damage or beetles are first observed on the leaves (late June), treat plants with carbaryl, methoxychlor, permethrin or rotenone. Repeat at 7 to 10 day intervals as necessary to control adult tuber flea beetles before they can lay eggs.

## Slugs

Most garden crops



### Injurious Stages and Damage

Slugs are greyish-brown, soft-bodied, slimy creatures that grow to 30 mm in length. They leave glistening trails of slime as they move. Slugs feed mostly at night by rasping holes in plant foliage. Small backyard gardens provide favorable humid living conditions and residue under which slugs can hide.

### Life History

Slugs overwinter as clear spherical eggs under boards or debris or in the soil. Occasionally they will overwinter as adults. Eggs hatch in late spring and young slugs are usually observed in midsummer. There is only one generation per year.

### Cultural Control

Dispose of all residue under which slugs can hide and lay eggs. Maintain a border of bare soil around the garden. Use traps such as boards laid on the soil to attract and concentrate slugs so they can be killed. Saucers of beer sunk into the soil will attract slugs and drown those that fall in. Keep the garden dry and plants well spaced.

### Chemical Control

Apply slug baits or pellets containing metaldehyde among the plants in the garden. Do not allow product to come into contact with plants. Protect baits from pets. Start control early in the season. Another alternative for control of slugs and snails is diatomaceous earth.



## Thrips

Onion, cabbage, pea, bean and other crops

### Injurious Stages and Damage

Onion thrips are pale yellow, greenish or brown. They injure plants by rasping at leaf tissues and consuming plant juices. This produces white or silvery blotches on the leaves and eventually browning and leaf death. Similar damage is caused by several other thrips species to peas, beans and cabbage. Flowers of many vegetables may be heavily infested.

### Life History

Adult thrips overwinter in crop refuse, greenhouses, weeds and grass. Eggs are laid in leaf tissue in the spring and hatch in about a week. Nymphs feed for a few weeks and then drop to the ground to pupate. There are three or more generations a year. Hot, dry weather favors a rapid population increase and dispersal flights over long distances.

### Cultural Control

Keep the garden free of weeds and refuse.

### Chemical Control

Apply diazinon, malathion or methoxychlor to foliage. Dust onion bulbs with malathion before storing or setting them out.

## Minor Insects

**Blister beetle** – These beetles can be black, bluish-black, green or purplish, usually with an iridescent sheen. They eat leaves of various legume plants. Spray or dust with malathion, methoxychlor or rotenone.

**Plant bugs** – These small bugs are brown, yellow or green. They suck sap from a wide variety of plants, causing distortion, bud blast and brown spots. Plant bugs may be very numerous, especially after hot, dry weather. Spray with carbaryl, malathion or permethrin.

**Red turnip beetle** – These red beetles have three black longitudinal stripes on their back. Larvae are black and rough-textured. Both adults and larvae feed on the leaves of crucifers. Hand-pick or dust with rotenone.

**Seed corn maggot** – These white, legless maggots attack germinating seeds of peas, beans, cucumbers, etc. Sow seed into warm, moist soil for speedy germination. Avoid spring manure application because it attracts egg-laying flies.

**Spider mites** – These tiny, sap-sucking creatures may be very damaging to peas, beans and cucurbits. They multiply rapidly in hot dry weather. Spray with diazinon or insecticidal soap.

**Spinach carrion beetle** – These black, segmented, shiny larvae chew holes in leaves of primarily spinach, beet, Swiss chard. Spray or dust with carbaryl or malathion.

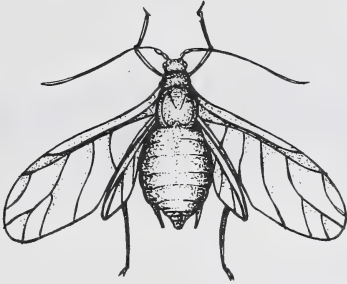
**Variegated cutworm** – This large, brown caterpillar eats into tomato fruit at night. Sift surrounding soil for larvae and destroy them. If necessary spray or dust plants with carbaryl.

# Insect Pests

## OF CONIFEROUS ORNAMENTALS

### Aphids

Most conifers



**Injurious Stages and Damage** Several species of aphid suck sap while feeding on the branches or needles of conifers. They reduce plant vigor and also excrete sticky honeydew on which an unsightly black mold grows.

**Life History** Most species attacking conifers overwinter as shiny black eggs on stems and needles. The eggs hatch in spring, and large brown or black aphids form colonies, often tended by ants. There are several generations a year.

**Cultural Control** Hose aphids off trees weekly with a forceful spray of water from a garden hose.

**Biological Control** Avoid spraying if large numbers of parasites or predators, such as lady beetles, are present.

**Chemical Control** If necessary, apply a foliar spray of carbaryl, chlorpyrifos, diazinon, dimethoate, insecticidal soap, malathion, permethrin or pyrethrum.

### Douglas Fir Pitch Moth

White spruce, pine, Douglas fir



**Injurious Stages and Damage** Larvae usually do not kill trees, although branches and tops of white spruce have been killed. Larvae construct horizontal tunnels in the bark cambium. Their feeding causes a large flow of resin, which hardens into conspicuous masses. On spruce, shapeless pitch masses are concentrated around wounds and/or branch bases. Attacks are spread throughout the lower crown but may occur at ground level.

**Life History** Pitch moths have a two-year life cycle, overwintering twice in the larval stage. Larvae pupate in the spring of the second year. Short-lived adults emerge in June and July. Females prefer to lay eggs near tree wounds. Moths resemble yellow jacket wasps: black head, bluish-black body with reddish-yellow bands on the abdomen. Larvae are creamy white with brown heads and are about 25 mm long at maturity.

**Cultural Control** Avoid injuring tree trunks with grass cutting equipment. Do not prune host trees in years when pitch moths are known to be abundant. Remove pitch masses and insert flexible wire into larval tunnels to destroy larvae.

**Chemical Control** There are no chemical controls.

## Pine Needle Scale

Spruce, pines, and occasionally Douglas fir



**Injurious Stages and Damage** Tiny, white elongated scaly insects suck sap from the needles, causing yellowish spots and premature needle drop. Tree vigor is reduced if heavy populations are present.

**Life History** This insect overwinters on the needles as eggs, beneath the scale covering. The insects hatch in early June and walk or are blown to other needles, where they insert their mouth parts and become stationary. As they develop they become flattened and secrete a white scale covering. The female lays eggs in mid-August.

**Biological Control** Predators and parasites generally exert some control.

**Chemical Control** If necessary, apply a foliar spray in mid-June or soon after new needles appear. Re-apply in early August to kill surviving females. Carbaryl, chlorpyrifos, dimethoate, permethrin or dormant oil can be applied before bud break.

## Sawflies

Spruce, larch, cedar, pine



**Injurious Stages and Damage** Several species of sawfly larvae defoliate conifers. Most are naked, greenish larvae, often with black heads. The larvae have six pairs of legs on the abdomen, in addition to the three pairs on the thorax. They are generally found feeding in groups.

**Life History** Most species overwinter in cocoons in the soil. Adults emerge in the spring or early summer and females insert eggs in host foliage. Larvae, when fully grown, descend to the ground to pupate. There is one generation a year.

**Cultural Control** Hand-pick larvae where practical.

**Chemical Control** Apply a foliar spray of carbaryl, diazinon, dimethoate, malathion or permethrin when larvae are first observed.

## Spruce Budworm

Spruce, balsam fir

### Injurious Stages and Damage



These yellowish to purplish-brown caterpillars are covered with small white spots. They have a light underside and a black head. Spruce budworms begin mining the buds in early to late May, feeding on the developing needles. As the buds elongate they feed openly, webbing the partially eaten needles together to form a shelter. In severe, consecutive infestations, all the new foliage and some of the older needles are consumed, so that the tree top and later the whole tree may die.

### Life History

Spruce budworms overwinter as young larvae in bark crevices. They emerge in early May and complete feeding by mid- to late June. Pupation occurs on the tree. Small, brownish-grey moths emerge in late June to early July. Females lay clusters of green eggs on the undersides of needles. Eggs hatch in about 10 days. There is one generation a year.

### Cultural Control

Hand-pick larvae early in the season where practical.

### Biological Control

Apply a foliar spray of *Bacillus thuringiensis* just after the new shoots have lost their bud caps.

### Chemical Control

Apply a foliar spray of carbaryl, dimethoate or permethrin when larvae first appear, and repeat as necessary.

## Spruce Gall Aphids

Spruce, pine, larch, fir, hemlock



### Injurious Stages and Damage

Several species of aphids cause the growth of variously shaped galls on new growth of spruce. The galls are initially green but later turn purple or brown before opening and releasing mature aphids. Pine, larch, fir or hemlock act as secondary hosts. On these and for later generations on spruce, the presence of aphids is indicated by white cottony specks on needles. The white fluff covers and protects the eggs and nymphs. Galls cause tip kill and the open-feeding stages may distort and yellow needles and give them a dirty appearance.

### Life History

The life cycle of these aphids is complex and varies with the species. On spruce, eggs are laid in the fall at the base of needles, the nymphs which hatch from these eggs overwinter. Further development occurs in early spring and adult females lay eggs near the buds. The nymphs that hatch from these eggs feed on the newly emerging needles. They become enclosed by gall tissue and feed within. When the galls dry in midsummer, the nymphs molt to females. Generations continue to cycle as the non-gall forming, "white fluff" stage.

### Cultural Control

Pick-off new galls as they are formed. Hose off the "white fluff" generation with a forceful spray of water.

### Chemical Control

To prevent gall formation, spruce must be sprayed with carbaryl or malathion just as the buds begin to open in early May. Control of the "white fluff" generations on host plants can be achieved with the same insecticides. Apply twice at 7 to 10 day intervals.

## Spruce Spider Mite

Spruce, juniper, cedar



### Injurious Stages and Damage

Damage is caused by adults and nymphs sucking the plant's sap. The foliage loses color and eventually dries up and drops. They also spin fine silken webbing, which traps dust particles, dandelion seeds and shed needles, giving the plant a dirty appearance. Discoloration typically is more evident at first in the inner portions of the plant and spreads outwards.

### Life History

This mite overwinters as tiny red eggs at the base of needles or under loose bud scales. Hatching occurs about mid-May and new adults are found by early June. New generations are produced every two to three weeks during the summer. Populations can build up rapidly if unchecked. Wet weather is detrimental to them.

### Cultural Control

Hose down trees and shrubs with a forceful spray of water once a week. Trim the lower branches to increase light and air circulation.

### Chemical Control

If infestations persist at damaging levels, apply a foliar spray of chlorpyrifos, diazinon, dicofol, insecticidal soap or malathion. Usually two sprayings are required per season, the first in the third week of May and the second in late June. Use different sprays for each application.

## White Pine Weevil

Spruce, occasionally pines



### Injurious Stages and Damage

White, legless larvae with brown heads feed under the bark of new leaders eventually girdling the stem. The leader wilts and dies. Usually two years of growth are affected. Open-growing trees less than 10 m high with a leader that is 13 mm or more thick are most likely to be attacked. Attacks result in crooked or forked trees.

### Life History

Dark brown, adult weevils overwinter in soil under infested trees. In the spring they feed on the soft inner tissues of the new leader and deposit eggs in the feeding punctures in late May. Resin beads indicate their activity. Larvae hatch in two weeks and travel downward as they feed. In late July, when full grown, they bore into the wood to form wood chip cocoons in which to pupate. Adults emerge from early August to late September, feed for a short period and then overwinter in the soil.

### Cultural Control

Prune out and burn all infested leaders in early July.

### Chemical Control

None are effective.



## Yellowheaded Spruce Sawfly

Spruce

**Injurious Stages and Damage** Yellowish green larvae, with yellow or orange heads, consume needles, particularly on open-growing trees. Heavily infested trees appear ragged, especially near the top, and take on a yellowish-brown color as defoliation increases. Successive years of heavy defoliation may kill the tree.

**Life History** Adult wasplike sawflies emerge from the soil from late May to mid-June. Female sawflies lay eggs at the base of developing spruce needles. Larvae hatch in about a week and feed on the new needles until mid-July. They drop to the ground where they form cocoons in the soil, and remain there until spring.

**Cultural Control** Hand-pick larvae where practical or hose down tree with a forceful spray of water from a garden hose.

**Chemical Control** Apply a foliar spray of malathion, permethrin or soap solution when larvae are small.

## Occasional Pests

**Bark beetles and wood borers** – Bark beetles burrow under the bark. Wood-boring beetles form galleries under the bark and into the wood. In backyards they generally only infest already dead and dying trees. There are no chemical controls. Remove infested trees and provide favorable growing conditions for the remaining trees.

**Spruce bud scale** – These irregular, rounded brown scales resemble buds. The scales suck sap from stems, reducing tree vigor. They are often overlooked. If numerous, apply dimethoate in early August when the crawler stage is active.

**Spruce gall midge** – The orange larvae cause small galls on new shoots at the base of needles. These midges are generally held in check by natural controls. Hand-pick twigs with new galls and destroy them.

**Spruce needle miner** – The green to yellow larvae chew circular holes at the base of spruce needles and consume needle contents in summer and fall. They overwinter in silken nests of grass and dead needles near the trunk. Sometimes severe damage results. Hose nests off of trees in spring.

**Web-spinning sawflies** – The yellowish-brown larvae feed on spruce needles, webbing them together in a mass. They drop to the ground to overwinter in the soil. Remove nests by hand and destroy.

# Insect Pests

## OF DECIDUOUS ORNAMENTALS

### Aphids

Most trees and shrubs



#### Injurious Stages and Damage

These small, pear-shaped, soft-bodied, variously colored insects are usually found in colonies. They suck sap from leaves, stems or roots causing loss of vigor, wilting, distortion or spots. They also excrete sticky honey dew on which black sooty mold grows. Some curl the leaves and are protected both by the leaf and a waxy coating.

#### Life History

Aphids overwinter as eggs on a perennial winter host. They hatch in spring and produce one or two generations before winged forms develop which fly to summer hosts. Several generations of living young are produced in rapid succession. In the fall, sexual forms are produced that mate and lay the overwintering eggs.

#### Cultural Control

Prune off and destroy heavily infested branches. Hose aphids off with water.

#### Chemical Control

Apply a foliar spray of one of the commonly available insecticides labelled for aphid control on your tree species.

### Ash Flower-gall Mite

Ash



#### Injurious Stages and Damage

Tiny mites attack the staminate flowers of ash, causing them to develop abnormally and form galls up to 12 mm in diameter. The dried-out clusters of galls remain on the tree through the winter.

#### Life History

Adult female mites overwinter on the trees and migrate to developing flower buds in the spring to lay eggs. Several generations are produced in the summer. Attacks are sporadic.

#### Cultural Control

Control measures are generally not necessary. They can be controlled with a dormant oil spray prior to bud break.

## Ash Plant Bug

Ash



**Injurious Stages and Damage** Small, greenish-yellow plant bugs with black or red markings suck sap from leaves, flowers, buds and seeds. They leave white feeding specks and black dots of excrement. When infestations are severe, leaves appear scorched.

**Life History** It is believed this pest overwinters as eggs on the tree. Nymphs and adults are numerous in July and August. There are two or more generations a year.

**Chemical Control** Apply a foliar spray of carbaryl as necessary.

## Birch Leaf Miner

Birch



**Injurious Stages and Damage** White, grublike, flattened larvae of three species of sawfly feed within the leaf tissue from early June onwards, producing pale green spots that expand into brown, blister-like blotches. Infested trees take on a brownish appearance.

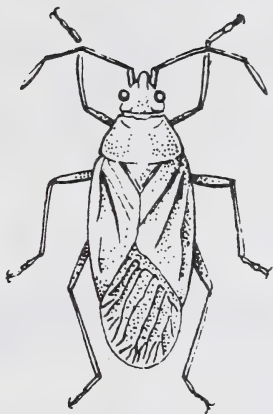
**Life History** Larvae overwinter in earthen cells in the soil. Small, black, wasplike adults emerge in mid-May and lay eggs in the upper leaf surface. Eggs of the common species hatch in early June. Larvae feed within the leaf and emerge in early June, dropping to the ground to pupate. There are one or two generations a year, depending on the species.

**Chemical Control** Apply one of the following treatments:

- A soil drench of undiluted dimethoate in early June at a rate of 50 ml per 2.5 cm diameter trunk, applied within the drip line in four or more shallow holes (approximately 2 cm in diameter). Fill the holes with soil and water well. Leaf burning occurs if the tree is not watered heavily.
- A foliage spray with either carbaryl, diazinon, dimethoate or malathion when leaves are fully opened; repeat in mid-June and again in early July.

## Box Elder Bug

Box elder (Manitoba maple)



### Injurious Stages and Damage

Both nymphs and adults suck nutrients from the seeds, foliage and tender twigs of female (seed-bearing) box elder trees. Nymphs are bright red when young. Adults are medium-sized, winged, grey-brown to black insects with a few conspicuous red lines on the body and red eyes. They occur primarily in south and south-eastern Alberta. Damage to trees is generally minor.

### Life History

Adult box elder bugs emerge from winter hibernation in spring and females lay red eggs primarily in crevices in bark. Nymphs, and late-season adults feed on developing foliage. In the fall, they congregate in sunny areas, from where they migrate to dry, sheltered places to hibernate. While migrating they frequently enter houses and become a nuisance.

### Cultural Control

If possible remove female box elder trees. Seal building to prevent the bugs from entering.

### Chemical Control

Apply a spray of carbaryl or diazinon to box elder trees. Use carbaryl if necessary on the exterior of buildings.

## Caterpillars

Many trees and shrubs



### Injurious Stages and Damage

Several species of caterpillars attack trees and shrubs, chewing holes in leaves or various portions of the leaves. Unless defoliation is severe, overall tree health will not be affected. Common caterpillars are linden loopers, cankerworms, woolly bears, and larvae of the pepper and salt moth, rusty tussock moth and tiger swallowtail butterfly.

### Life History

Life history varies depending upon the species of caterpillar. Most overwinter as pupae in the ground, and the moths or butterflies emerge in the spring to lay eggs on leaves. Caterpillars grow and feed for two to four weeks (longer for a few). The great majority have only one generation a year.

### Cultural Control

Hand-pick and destroy caterpillars.

### Biological Control

If necessary, apply a foliar spray of *Bacillus thuringiensis*.

### Chemical Control

Apply a foliar spray of one of the commonly available insecticides labelled for caterpillar control on your tree species.

## Forest Tent Caterpillar

Poplar, apple, other trees and shrubs

**Injurious Stages and Damage** These large, blue/black caterpillars, marked with a row of keyhole-shaped white spots along the back, chew holes in new foliage or completely defoliate trees and shrubs. They tend to stay in groups, particularly when resting at night. They periodically occur in outbreak numbers, infesting large areas. Several years of heavy defoliation will result in die-back, reduced growth and death of trees under stress.



**Life History** Forest tent caterpillars overwinter as eggs in brown bands around twigs of broad-leaved trees and shrubs. The eggs hatch about the time the trembling aspen (poplar) leaves unfold in mid-May. Larvae complete their growth in five to eight weeks and spin yellowish cocoons on leaves and buildings, where they pupate. The brown adult moths emerge about 10 days later in early July and disperse before the females lay the overwintering egg bands.

**Cultural Control** Remove egg bands and destroy them before the larvae hatch in the spring. Hand-pick colonies of larvae

**Biological Control** Apply a foliar spray of *Bacillus thuringiensis*.

**Chemical Control** Apply a foliar spray of carbaryl, diazinon, malathion, methoxychlor or permethrin when larvae are small.

## Gall Insects and Mites

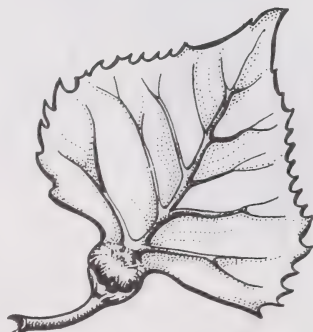
Poplar, elm, other trees and shrubs

**Injurious Stages and Damage** Gall mites are almost invisible to the naked eye, whereas insects such as gall aphids and gall midges are quite visible when galls are opened. The galls usually take the form of bumps, fingerlike extensions or felty growths on leaf surfaces and sometimes on petioles or stems. They rarely cause any serious damage. Common examples are poplar leaf-petiole gall aphid, box elder leaf gall midge, oak petiole gall wasp, elm finger gall mite, and rose leaf and stem gall wasps.

**Life History** The life histories are very complicated and for some species not well known. Most mites overwinter under bud scales, bark and other protected places and move onto new growth in the spring. Aphids often have an alternate summer host. Galls are formed by the plant in response to feeding by the pest. Development of the insect proceeds within the gall. Adults may emerge in spring or fall, depending on species.

**Cultural Control** Prune out galls as they form, when practical.

**Chemical Control** Chemical control is difficult and timing is critical, so it is generally not recommended. For damaging populations of gall mites on valuable trees, use a dormant oil just prior to bud-break and follow with a foliar spray of carbaryl or chlorpyrifos as the new leaves expand. Repeat foliar spray after 7 to 14 days.



## Large Aspen Tortrix

Poplar, birch, alder



### Injurious Stages and Damage

The principal host, aspen poplar, is attacked by dark green caterpillars with black heads. They chew into developing buds in early spring, making holes in the new leaves. Later they tie several leaves together with silken threads, forming a tent in which they continue to feed. This is a serious pest during outbreaks which may last two to three years.

### Life History

Young larvae overwinter at the base of trees. They enter buds in early May. Older larvae consume leaves in their tents until early to mid-June, when they pupate within the tent. Non-descript grey moths emerge two weeks later and lay clusters of eggs on the upper surface of trembling aspen leaves. Tiny larvae web leaves together and skeletonize the leaf surface before congregating at the base of the tree in early August to overwinter.

### Cultural Control

Prune out webbed leaf clusters.

### Chemical Control

Apply a foliar spray of carbaryl when larvae or damage is first observed.



## Leaf and Flea Beetles

Poplar, willow

### Injurious Stages and Damage

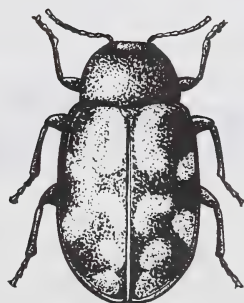
Adults and larvae of a number of species feed on foliage, chewing holes in leaves or skeletonizing them. Adult leaf beetles are small, black, brown or black and yellow insects, which often drop to the ground when disturbed. Flea beetles are very small, shiny-black beetles which hop. Larvae of both insects are slender and black or black and yellow. They are usually found in clusters on leaf undersides.

### Life History

Adult flea and leaf beetles overwinter on the ground under dead vegetation or litter. Eggs are laid on the leaves from late May onwards. Larvae complete development on the leaf and pupate there. Most species have more than one generation a year, so all stages may be found on the host by late summer. Infestations tend to be sporadic.

### Chemical Control

Apply a foliar spray of carbaryl, insecticidal soap or methoxychlor as necessary.



## Lilac Leaf Miner

Lilac



**Injurious Stages and Damage** Small, flattened, yellowish caterpillars mine initially within the leaf causing yellow or brown blotches. They then exit, roll up the leaf from the tip, and continue to feed, skeletonizing the upper leaf surface. Damage is unsightly but not fatal.

**Life History** Pupae overwinter in the soil. Tiny, greyish moths emerge in late spring, and females lay eggs on the undersides of leaves. The eggs hatch in early July and larvae burrow into the leaf, feeding for a few days before emerging to continue feeding in the rolled leaves until mid-July. They drop to the ground to pupate. In early August, a second generation of moths will appear.

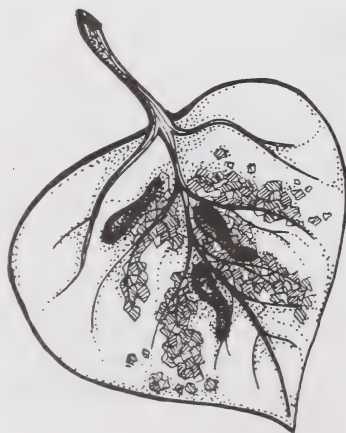
**Cultural Control** If few in number, hand-pick infested leaves and destroy them.

**Chemical Control** Apply either:

- Dimethoate to main stems as a paint-on band treatment, or
- A foliar spray of diazinon, dimethoate, malathion when damage is first seen.

## Pear Slug

Fruit trees, cotoneaster, mountain ash, hawthorn



**Injurious Stages and Damage** Small, dark, slimy, sluglike larvae feed on the upper leaf tissue, causing brown-colored marks on the leaves. Leaves may later appear scorched if damage is severe. Because most damage occurs late in the season, plant growth is not seriously affected.

**Life History** Pear slugs overwinter in earthen cocoons just below the soil surface. Adult sawflies lay eggs singly on the underside of leaves in late June. Larvae feed for two or three weeks, turning bright orange when mature. A second, much more numerous generation appears in mid-August.

**Cultural Control** Hose larvae off trees with a forceful spray of water from a garden hose.

**Chemical Control** Apply a foliar treatment of carbaryl, insecticidal soap, malathion, pyrethrin or rotenone when larvae or damage is first observed.



## Poplar Bud-gall Mite

Poplar

**Injurious Stages and Damage** Cauliflower-like galls are formed from new leaf clusters in the spring by the feeding of tiny mites. Galls grow actively for three to four years, resulting in stunted and crooked branches, particularly lower ones. It is a serious pest in southern Alberta on hybrid poplars.

**Life History** Mites spend the winter inside an active gall and in the spring either feed on the gall's new growth or migrate to unfested buds where they form new galls. A new generation is produced every two to three weeks. Mites may be blown to other trees, where they start a new infestation.

**Cultural Control** Prune out and burn all galls on dormant trees in the fall and new ones as they form. Native trees and some hybrids such as Griffin or Walker are more resistant to attack. Maintain trees well, keeping them fertilized and watered.

**Chemical Control** None available. Trees tolerate infestations.

## Sawflies

Willow, birch, poplar, rose and others



**Injurious Stages and Damage** Larvae resemble caterpillars but have at least six pairs of legs on the abdomen in addition to the three pairs on the thorax. Most species are green with brown or black heads, and black or black and yellow spots or stripes on the body. When touched the tail end is raised up in the air. They often feed in groups, either skeletonizing leaves or feeding in from the edges.

**Life History** Most overwinter as larvae in cocoons in the soil, completing development in the spring. Adult sawflies emerge in May to June and lay eggs in the leaf, which hatch about three weeks later. The larvae feed for three weeks or more before dropping to the ground to spin their cocoons. There is one generation a year.

**Cultural Control** Hand-pick larvae when possible.

**Chemical Control** Apply a spray of carbaryl, diazinon, malathion or permethrin as necessary.

## Spider Mites

Elder, mountain ash, other trees and shrubs



**Injurious Stages and Damage** Damage is caused by both the tiny, sap-sucking adults and nymphs feeding on leaf undersides. Leaves show speckles and as damage becomes more severe, lose color and dry out. Fine webbing may be visible.

**Life History** Adults may be carried on infested nursery and greenhouse plants. Females lay clear, spherical eggs on leaf undersides. Nymphs may complete development in a week.

**Cultural Control** Hose down plants frequently with a forceful spray of water from a garden hose.

**Chemical Control** Apply a spray of either chlorpyrifos, dimethoate, insecticidal soap or malathion at 7 to 14 day intervals as necessary.

## Western Ash Bark Beetle

Green ash



**Injurious Stages and Damage** Western ash bark beetle is capable of killing healthy trees. Adults excavate egg galleries beneath the bark and chew ventilation holes through the bark at frequent intervals. The ring of pin-sized ventilation holes around twigs is characteristic of attack by this species. Larvae girdle twigs or branches and occasionally, when attacks are numerous, the trunk. Leaves on girdled branches turn bright yellow ("flag") by July and August.

**Life History** Adults emerge from hibernation chambers in the rough outer bark on the trunk at the base of ash trees in late May or early June. Beneath the bark, larvae chew deep tunnels that roughly parallel the grain of the wood. New adults emerge 35 to 45 days later, feed in the axils of new branches, then move down to base of the tree where they construct hibernation chambers.



**Cultural Control** Remove and burn flagged branches below the egg gallery, in late June or early July. Maintain vigorous growth through proper watering, fertilization and pruning. Check the base of infested tree trunks and those of nearby ash trees late in the fall for small beetle entry holes. If you find holes, insert a piece of wire in the holes to kill beetles.

**Chemical Control** No chemicals are yet registered for this use.

## Willow Red Gall Sawfly

Willow



### Injurious Stages and Damage

Pale larvae feeding in the leaf produce green, yellow or red oval galls the size of cherry pits on the leaf surface, each containing a single larva. Low populations will not harm the tree or shrub. Once the gall is present, chemicals are not effective.

### Life History

Larvae overwinter in the galls on fallen leaves. Small black, adult sawflies emerge in spring and mid-summer, and females lay eggs in the leaf. Feeding by larvae causes the galls. There are two generations a year.

### Cultural Control

Prune galls off as they form, and collect and burn leaves in the fall.

### Chemical Control

Some control of the early generation has been reported with one of many sprays applied on newly developing leaves. Usually no control is necessary.



## Wood Borers

Poplar, willow, birch, ash, elm, etc.

### Injurious Stages and Damage

White, legless larvae of several species of beetles and moths bore into the sapwood of trees. External symptoms include holes in the bark through which the insect expels sawdust-like excrement. Small branches may wilt. There may be death of branches or whole trees. Diseases often gain a foothold. Common borers include: long-horned and metallic wood borers in poplar; carpenterworms in ash and poplar; bronze birch borer in birch; and poplar-and-willow borer in poplar and willow.

### Life History

The life cycle varies with the species of insect involved; most take two years or more to complete. Eggs are generally laid in the bark. Larvae bore into the tree and eventually pupate in their tunnels. Adults emerge in the spring to mate and lay eggs. Most common species are beetles in the adult stage except carpenterworms, which develop into large grey moths. Satisfactory controls have not been developed.

### Cultural Control

For carpenterworms, wrap trunks with burlap from May to August to prevent adult moth emergence and egg-laying. For poplar borers, remove heavily infested "brood trees". Push flexible wire in new holes to kill larvae. For shoot-borers, prune out and destroy infested shoots.

### Chemical Control

None are available.

## Occasional Pests

**Green rose chafers** – These small, metallic green beetles periodically become numerous and feed on trees, shrubs and herbaceous plants. Spray with carbaryl, diazinon, insecticidal soap or malathion if necessary.

**Leafhoppers** – Generally pale yellow or green wedge-shaped insects that feed by sucking sap from various plants such as Virginia creeper and box elder. Spray with carbaryl, insecticidal soap, malathion, methoxychlor or pyrethrins.

**Leafminers** – Larvae of several species of beetles, sawflies, moths and flies mine within the leaves of poplar, elm, alder, honeysuckle and other trees and shrubs. Spray with carbaryl, dimethoate or malathion at the first sign of damage. Check label for plant species sensitivity.

**Lecanium scale** – These brownish, rounded, budlike insects attach themselves to small twigs of elm and fruit trees. Prune infested branches or apply dormant oil before bud break.

**Plantbugs** – These small insects are brown, yellow or green. They suck sap from a wide variety of plants, causing distortion, bud blast and brown spots. They may be numerous, especially after hot, dry weather. Spray with carbaryl or malathion.

**Scurfy scale** – These white, flattened, sucking insects cause branch dieback on apple and cotoneaster. Prune infested branches and apply dormant oil before bud break. The alternative is to spray with diazinon or malathion at one week intervals starting June 1.

# Insect Pests

## OF SMALL FRUITS

### Aphids

Most fruits



#### Injurious Stages and Damage

These small, pear-shaped, soft-bodied insects are usually found in colonies. Nymphs and adults damage crop plants by sucking sap. Several species transmit viruses. Symptoms of feeding include yellowing, stunting and leaf distortion. Some species excrete sticky honeydew.

#### Life History

Most aphids overwinter as eggs on stems of perennials. These eggs produce aphids that give birth to live young. Winged adults are produced whenever population densities are high and in fall. Both males and females develop in late fall, mate, and eggs are laid.

#### Cultural Control

Hose down plants with a forceful spray of water directed at the aphid colonies.

#### Chemical Control

Ensure good coverage if using rotenone dust, or spray thoroughly with diazinon, insecticidal soap, malathion or rotenone.

### Caterpillars

All fruit species



#### Injurious Stages and Damage

Caterpillars are the larvae of moths and butterflies (feed mainly on leaf tissue). They may be up to 5 cm long and any color. Damage may consist of removal of all or part of leaf blade, leaf skeletonization or leaf mining.

#### Life History

Depending on species, eggs may be laid on or near host plants at any time during the season. Hatching may occur immediately, or eggs may overwinter. There may be one or several generations per year. They may overwinter in any stage.

#### Biological Control

Apply a foliar spray of *Bacillus thuringiensis*.

#### Chemical Control

Ensure good coverage if using rotenone dust, or spray thoroughly with diazinon or malathion.



## Currant Fruit Flies

Currant, gooseberry, saskatoon

**Injurious Stages and Damage** The legless white larvae cause "wormy fruit". Larvae develop within fruit, which turn red and drop prematurely.

**Life History** Small yellowish flies with dark bands on their wings emerge from pupae in the soil. Eggs are deposited singly into developing berries, where larvae develop.

**Chemical Control** Two applications of malathion or methoxychlor, the first just after petal fall and the second 10 days later.

## Imported Currantworm

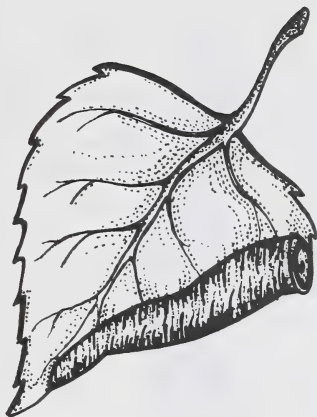
Currant, gooseberry

**Injurious Stages and Damage** The larvae are leaf feeders and when feeding in groups can completely defoliate a bush in early spring. When mature, they are green and almost 2 cm long. Disturbed larvae raise front and rear ends of their bodies.



**Life History** Eggs are laid on the underside of leaves in May and June. Larvae feed for two to three weeks, then pupate in leaf litter. The yellow and black adult sawflies deposit their eggs in midsummer. Larvae or pupae from this second generation overwinter. Adults emerge in May and June.

**Chemical Control** Ensure good coverage if using rotenone dust, or spray thoroughly with diazinon, malathion or a soap solution.



## Leaf Rollers

Strawberry and various other species

### Injurious Stages and Damage

Larvae feed on fruit, buds and leaves. Typical symptoms of infestation include a leaf or leaves rolled together and fastened with silk. The greenish-white larvae live in these leaf tubes.

### Life History

They overwinter as eggs, sometimes in egg masses attached to twigs, branches and occasionally trunks. Larvae hatch at bud break and feed on leaf tissue within rolled or folded leaf tubes.

### Chemical Control

Apply malathion thoroughly as a foliar spray at the first sign of damage.

## Raspberry Crown Borer

Raspberry



### Injurious Stages and Damage

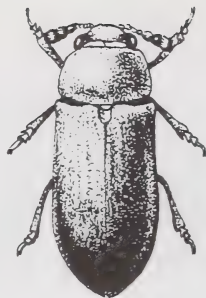
Thick bodied, white larvae damage plants by tunnelling extensively in bases of canes, crowns and roots. Mature larvae may be up to 25 mm long.

### Life History

Eggs are deposited on foliage in late summer. Larvae burrow into bases of canes where they winter. Development continues during the second summer. Larvae pupate in the bases of canes; the yellow and black adults emerge in midsummer.

### Chemical Control

Apply diazinon as a drench to the crown area in October or in spring when new shoots are about 10 cm high.



## Raspberry Fruitworm

Raspberry

**Injurious Stages and Damage** These tiny brown beetles feed on emerging foliage, damaging unfolding leaves, buds and blossom clusters. Heavy feeding may reduce the crop. Wormlike larvae penetrate flower buds and developing fruit; wormy fruit cannot be marketed.

**Life History** The brown beetles emerge from the soil in April and May. Eggs are deposited on flower clusters or developing fruit. Mature yellow larvae drop to the ground, pupate and become adults, which is the overwintering stage.

**Chemical Control** Apply diazinon or rotenone when berries start to form.

## Sawflies

Various fruits of rose family



**Injurious Stages and Damage** Caterpillar or sluglike larvae are foliage feeders. In severe cases entire bushes may be stripped.

**Life History** Larvae or pupae usually overwinter in underground cocoons. Wasplike adults emerge in spring and place their eggs into or on leaves. There are up to three generations per year, depending on species.

**Chemical Control** Apply diazinon or rotenone as a foliar treatment.



## Slugs

Strawberry, blueberry

**Injurious Stages and Damage** Immature and mature slugs (up to 30 mm long) feed primarily at night, rasping holes in foliage and gouging grooves into ripe and unripe fruit. Slugs may leave slime trails.

**Life History** Clear, spherical eggs are laid in moist places such as under boards, in plant debris, etc., where they overwinter. Slugs appear in late June and multiply rapidly under moist conditions. Young resemble adults.

**Cultural Control** Dispose of all residue under which slugs can hide and lay eggs. Maintain a border of bare soil. Use traps such as boards laid on the soil to attract and concentrate slugs so they can be killed. Saucers of beer sunk into the soil will attract slugs and drown those that fall in.

**Chemical Control** Apply slug baits or pellets containing fresh metaldehyde. Do not apply to plants. An alternative is to apply diatomaceous earth. Start treatment in July.



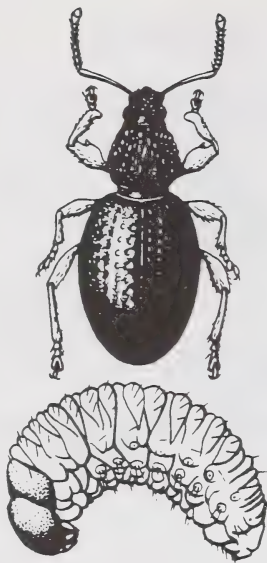
## Spider Mites

All fruits

**Injurious Stages and Damage** Both nymphs and adults suck plant juices, usually from the undersides of leaves, resulting in a yellow stippling of upper leaf surfaces. Heavy infestations produce webbing on leaves and stems and may cause leaves to dry up completely. In strawberries, mites attack young leaves in crowns, resulting in crinkled, stunted and browned leaves; no fruit will form. Females winter on soil in protected areas. In spring, eggs are laid on plants. Under hot, dry conditions, a new generation may occur every two weeks.

**Life History** Hose down plants with a forceful spray of water directed at the infested parts.

**Chemical Control** Use diazinon, dimethoate, insecticidal soap or malathion, depending on the species of plant being treated.



## Strawberry Root Weevil

Strawberry, raspberry, blueberry

**Injurious Stages and Damage** Plants are damaged primarily by the white legless larvae feeding on roots and crowns. Plants appear stunted and the leaves may be bunched. Adult feeding results in "notched" leaf margins.

**Life History** This black beetle overwinters in the soil, emerges in late May and deposits eggs near host plants. Some of the larvae develop into adults; others overwinter as pupae or larvae.

**Chemical Control** Apply one of the following when leaf notching is first seen: diazinon, malathion, methoxychlor.

# Insect Pests

## OF TURF GRASS

### Ants



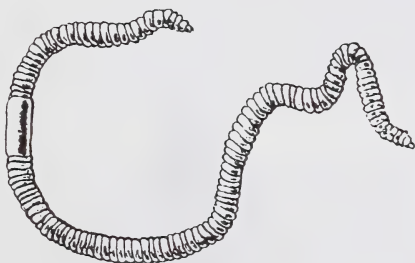
**Injurious Stages and Damage** Ants live in nests in the soil and may form large mounds. As mounds are pushed up, plant roots are cut. The mounds smother the turf and are unsightly. Passages are dug through the soil and cause irregular drying.

**Life History** Ants live in colonies that may have thousands of individuals. Ants can be helpful, as they eat decaying organic matter and harmful insects.

**Chemical Control** Carbaryl – do not water for two days after treatment; repeat in two to three weeks if necessary.  
Chlorpyrifos – treat nest and surrounding area.  
Diazinon – water lawn thoroughly after treatment.

Note: A Borax and sugar mix is not recommended because borax is highly toxic to green plants.

### Earthworms



**Injurious Stages and Damage** Earthworms can grow to 20 cm. Their burrowing and hard casts make a lawn lumpy and difficult to mow. Earthworms burrow through the soil feeding on organic matter and will feed on dead leaves and stems at the soil surface. They decompose thatch, mix organic material through the soil, and aerate the soil with their tunnelling.

**Life History** Earthworms need a moist environment. Soils with high worm populations often have high organic matter levels. Saline soils, sandy soils and soils with a pH of 4.5 or lower usually have few worms. Earthworms are normally found in the top 30 to 45 cm of the soil. They come to the surface at night and after heavy rains.

**Chemical Control** Apply carbaryl and water thoroughly after treatment.

## Glassy Cutworm



### Injurious Stages and Damage

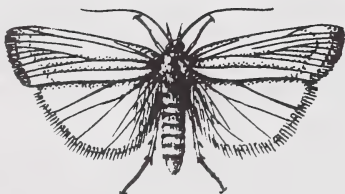
The immature (larval) stage is a cutworm. The body is smooth, round, thick and segmented, and a dull greenish-grey, brown or black color with a dark head. Mature larvae are 3.5 to 5 cm long. When disturbed the larvae curl into a "C" shape. At night the larvae feed around the mouth of the tunnels they live in during the day. They eat the stems, leaves and crowns of any type of grass.

### Life History

The adults, grey-brown moths, are active at night. The wings span 2.5 to 3.7 cm and are marked with light and dark spots and bands. The forewings are darker than the hind pair. Adults are often attracted by street lamps at night. A few days after eggs are laid on grass blades the larvae hatch and start feeding. The full-grown cutworm tunnels into the soil to spend the winter as either a larva or pupa.

**Chemical Control** Diazinon

## Sod Webworm



### Injurious Stages and Damage

The caterpillars are up to 2 cm long, a dirty white or tan color with a dark brown head, and may have rows of darker spots on their backs. Damage begins as irregular brown patches in the turf, which grow larger and can cover entire lawns. Damage is most severe during the late part of the summer. All grasses are attacked, especially bentgrasses, bluegrasses and newly seeded lawns.

### Life History

The adults are 6 to 12 mm long, tan colored, and may have a white stripe on the edge of the forewing. The moths hide in the grass during the day and fly a zigzag path during warm evenings in late May and June. Eggs are laid throughout the lawn, hatching on the leaves in 6 to 10 days. The young larvae mine the leaf surface as they work their way to the soil to build tunnels. Webworms cease feeding in late September and overwinter in the soil or thatch. They pupate in spring and emerge as moths.



### Chemical Control

Apply insecticides about two weeks after moths appear.

Carbaryl – do not water after treatment.

Chlorpyrifos – do not water for 12 to 24 hours after treatment.

Diazinon – water well after treatment.

# Insect Pests

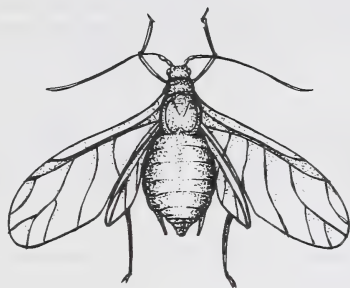
## OF FLOWERS

### Aphids

Annuals and perennials

#### Injurious Stages and Damage

Aphids are small, soft-bodied, pear-shaped, slow moving insects. Adults may be winged or wingless and nymphs are wingless. They are usually shades of green but may be black, yellow or pink. Aphids frequently cluster on the petals, leaves or stems. They feed by sucking plant fluids. This causes discoloring of leaves, leaf curling, wilting, distorted buds and loss of flowers. Severely infested plants may die. Plants may be covered by honeydew, a sticky substance that is excreted by the aphids. A black sooty mold can develop on the honeydew. Aphids are capable of spreading fungal and viral diseases.



#### Life History

Most aphids overwinter as eggs on perennial and woody plants. In the spring, the eggs hatch into wingless females that produce live female young within a few days. This new generation gives birth to a second generation of females. This process continues throughout the summer. Aphids have the ability to reproduce without mating. If conditions become overcrowded, winged females are produced which fly to new host plants. In the fall, male aphids are produced for the first time. They mate with sexual females which then lay overwintering eggs on suitable plants.

#### Cultural Control

A forceful spray with water from a garden hose will remove aphids. Insecticidal soap may also be used.

#### Chemical Control

Apply diazinon, dimethoate, insecticidal soap, malathion, pyrethrin or rotenone

### Blister Beetle

Annuals, perennials, especially delphinium and aster

#### Injurious Stages and Damage

Blister beetles are usually long, slender and somewhat cylindrical with a broad button-shaped head distinct from the body. Most are dark-colored (black, purple or metallic green). The adults eat roundish holes in the foliage.

#### Life History

Blister beetles have a complex life history. The larvae differ in appearance and habits from one stage to the next and most prey on grasshopper eggs. Apparently, most species have one generation per year.

#### Cultural Control

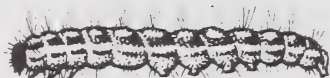
Wear gloves when handpicking because insects secrete cantharadin, a substance that may cause blisters to form.

#### Chemical Control

Carbaryl



## Caterpillars All herbaceous ornamentals



**Injurious Stages and Damage** Caterpillars are the wormlike larvae of moths and butterflies. They are of various shapes and colors, but the majority have cylindrical soft bodies which are naked, hairy or adorned with spines. These pests attack a wide range of plants. Some feed from within rolled leaves. Others skeletonize leaf surfaces or feed on the leaves until consumed. Damage may occur throughout the growing season.

**Life History** Moth larvae spin silken cocoons in which to pupate. Butterfly larvae form naked, variously colored and often sculpted cocoons. Within these structures they transform to the adult and emerge within a couple of weeks to lay the eggs. There is generally one generation per year.

**Cultural Control** Remove egg casings in the fall. For small infestations remove caterpillars by hand or pruning.

**Biological Control** *Bacillus thuringiensis*.

**Chemical Control** Carbaryl, diazinon, insecticidal soap, malathion, methoxychlor or rotenone

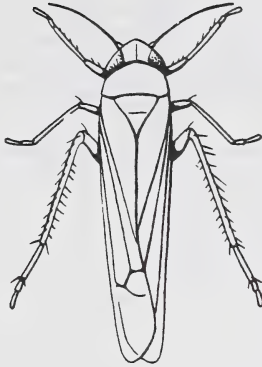
## Gladiolus Thrips Gladiolus, iris and lily



**Injurious Stages and Damage** Adults are very small, slender, brownish-black insects about 1.4 mm long with feather-like wings. They feed on any part of the plant. Both adults and nymphs injure plants by rasping the plant tissue and sucking exuded plant sap. A silvery, streaked appearance develops on the leaves, and flowers become flecked and spotted. Sometimes entire spikes are deformed.

**Life History** Adults overwinter on the stored corms. Infested corms are sticky, corky and russeted. Adults become active in spring after planting and lay eggs in slits on leaf surfaces. Under favorable weather conditions, several generations may occur each season. Adults will fly in the summer from one gladiolus patch to another.

**Chemical Control** Dust corms with carbaryl prior to storage. Storage at 2 to 4°C for four months will kill thrips. At first sign of damage in the summer spray with carbaryl, malathion or methoxychlor.



## Leafhoppers

Virginia creeper, roses, annuals and perennials

### Injurious Stages and Damage

Feeding by nymphs and adults on the undersides of leaves cause small whitish spots that later turn brown. Leaves become yellow and die. Plants may become stunted with a general decline in vigor. Leafhoppers are small (up to 6 mm long), slender, sap-sucking insects that hop away quickly when disturbed. They are usually pale green to medium green, yellow or white in color.

### Life History

Some species overwinter as adults under trash or other protected places. Other species are believed to migrate in from the south. Adults emerge in spring to feed and lay eggs in leaf tissue. The number of generations per year varies with species and weather conditions.

### Chemical Control

Carbaryl, malathion, methoxychlor or pyrethrins.



## Rose Curculio

Roses

### Injurious Stages and Damage

Adult weevils are about 8 mm long, with a bright red back and black undersides and long black snouts. Small, white, legless, curled grubs are found inside the rosebuds and hips. The adult weevils chew holes into the flower buds, thus petals are riddled with holes or the buds fail to open.

### Life History

There is one generation each year. The larvae overwinter in the soil around the base of roses. Pupation occurs in the spring and the adults emerge when the roses are in bud. Eggs laid in flower buds hatch into larvae, which feed and drop to the ground to overwinter when mature.

### Cultural Control

Remove infested hips and adult weevils by hand.

### Chemical Control

Apply carbaryl, diazinon or malathion. Many rose treatments include a fungicide and one or more of these insecticides.



## Rose Gall Wasps

Roses

**Injurious Stages and Damage** Several species of wasplike insects lay their eggs in stems of roses causing large swellings or galls. Galls may resemble hairy moss on the stem or large wartlike swellings covered with spines.

**Life History** Insects overwinter in the galls. Adults emerge in the spring. One generation occurs per year.

**Cultural Control** Prune out and destroy infested stems.

**Chemical Control** Apply dimethoate as soil drench in the spring.

## Spider Mites

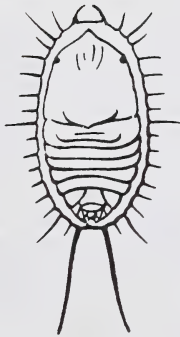
Herbaceous ornamentals



**Injurious Stages and Damage** Mites are minute (under 1 mm long) and difficult to see. They appear as tiny reddish-yellow to light green specks on the undersides of the foliage, usually associated with a fine webbing, which gives the leaf undersurface a dirty, dusty appearance. Mites feed by sucking sap from leaves which causes a yellow stippling developing into a blotched appearance. Eventually leaves turn brown and fall off. The plant becomes stunted with deformed leaves and buds.

**Life History** Mites are not insects. Depending on the species, they overwinter as eggs, nymphs or adults in protected areas. They become active in the spring as new foliage appears. Females lay their minute spherical eggs on the host. There are several nymphal stages before adults appear. There are usually six to eight overlapping generations per year.

**Chemical Control** Diazinon, dimethoate, insecticidal soap or malathion.



## Whiteflies

Annuals and perennials, especially coleus, fuchsia, hollyhock and impatiens

### Injurious Stages and Damage

Adult whiteflies are small (1 to 2 mm), delicate insects covered with a white powdery wax. They resemble tiny moths and swarm when plants are disturbed. Nymphs appear as soft, flat, oval spots on the undersides of leaves. All stages suck sap causing leaves to yellow and die. Severely infested plants wilt. Leaves become coated with sticky honeydew on which a black sooty fungus grows.

### Life History

There are continuous generations in greenhouses. Whiteflies overwinter only in greenhouses. Small white "crawlers" move around on leaves after eggs hatch. Nymphs are fully developed in two weeks and the complete life cycle takes about four weeks. In the summer whiteflies can infest plants outdoors.

### Chemical Control

Insecticidal soap, malathion, methoxychlor or pyrethrum.

# Wasps and Bees



Wasp

**Description** Wasps are generally black with yellow or pale-green markings or stripes. They are generally hairless. The most common species are the yellow jacket, (about 12 mm in length) and the hornet, (about 19 mm in length).

Honeybees are brownish-yellow, hairy, and about 12 mm long. Bumblebees are large hairy insects and are much larger and broader than honeybees and wasps. Bumblebees are generally black with a yellow or orange band on the abdomen. Although capable of stinging, bumblebees are non-aggressive and are rarely a nuisance.

**Economic Importance** Most wasps including the yellow jacket and hornet are scavengers, primarily feeding on other insects and food remnants. Wasps often congregate at garbage cans.

Honeybees and bumblebees are highly beneficial as pollinators of crops and fruit bearing plants. Adults only feed on nectar and pollen from flowers.



Honeybee

**Distribution and Life History** Wasps and hornets overwinter as fertilized females (queens) in protected places, frequently near homes and buildings. Queens emerge in April or May and select nest sites. Nests may be above or below ground and are made of wood fibre chewed to resemble paper. Wasp and hornet nests are often found hanging from a tree branch. They are papery, grey and egg-shaped with an entrance at the bottom. Nests of yellow jackets may become very large by late summer, often 30 to 35 cm in diameter; hornet nests are generally smaller, less than 8 cm in diameter.

Bumblebee females overwinter and build new nests in spring, similar to wasps. Bumblebee nests are small, comprised of a few dozen individuals. Favorite nest sites include insulation material between walls.

Honeybees overwinter as a colony. Nest sites may be occupied for years.

**Management and Control** Determine where wasps or bees enter and exit a building, wall or nest. Do not disturb the site during the day. At dusk or later remove nests when they are still small; on larger nests insert the nozzle of the "Wasp and Hornet Killer" sprays and spray non-stop for approximately 30 seconds. Close the entrance with pieces of cloth, then spray the cloth until it is soaked. If wasps establish a new entrance during the next few days, repeat the procedure. Do not disturb the nest for a couple of days after treatment. Wash your hands thoroughly after a spray application.

A pop bottle containing 5 cm of pop makes an effective trap for wasps, particularly in the spring when wasps are relatively few in number. Wasps are attracted to the sweet liquid and crawl in the bottle and drown. Place one or more bottles at sites where wasps frequent.

A piece of bacon can also be used as bait for a wasp trap. Hang a piece of bacon above a pail of water with a few drops of soap in the water. The wasps will gorge on the bacon, fall into the water and drown.

A garbage can with a tight fitting lid will reduce or minimize the attractiveness of garbage to wasps.



Bumblebee

# Weed Control

FOR HOME GROUNDS

**W**ell-kept grounds, whether simple or elaborate, provide an attractive surrounding for a home. Controlling unwanted plants (weeds) to maintain an attractive appearance demands more time and energy than any other gardening chore. This section provides a guide to recommend cultural and chemical means for controlling weeds in your lawn, garden and ornamental plantings.

Effective weed control requires proper identification of the weed problem, followed by good cultural or herbicide treatment at the correct time. Sound management, including the use of good growing practices, and cultural weed control methods in conjunction with herbicides, is essential for good weed control.

Understanding the biology of weeds is critical in developing weed control strategies. The main strategies in controlling annual weeds are to prevent seed production and reduce the number of seeds existing in the soil. With perennials, destruction of the root system is the key. Non-chemical weed control techniques exploit the biological differences between the crop and the weed and are accomplished through cultural practices, such as mowing, hoeing and tillage.

## Life Cycles and Control Strategies

### Annuals

There are two types of annual weeds: summer and winter annuals. Summer annuals germinate in the spring, produce seed during late summer or fall, and then die. Some examples are chickweed, purslane and pineapple weed. Winter annuals germinate in late summer or fall, producing rosettes that overwinter and grow early the following spring. Seeds are produced in the early summer. Some examples are stinkweed, and shepherd's-purse. Some weeds are both winter and summer annuals. Because annual weeds reproduce only by seeds, control is simple. Kill the plants before seed production occurs and encourage seed germination when the seedling weeds can be easily destroyed. This strategy can be thwarted by the tendency of these weeds to grow and mature very quickly. Winter annuals can often flower before all the spring snow is gone.

#### General control recommendations

- *Till or hoe between rows of vegetable crops.*
- *Rake or harrow to control weeds before garden plants emerge.*
- *Use pre-seeding tillage to get annual weeds to germinate before seeding.*

### Biennials

These weeds require between 12 and 24 months to complete their life cycle. In the first year a taproot and shoot are produced. The root survives the winter and in the spring the shoot bolts, producing flowers and seeds. Biennials are controlled by fall or spring tillage. Biennials can be a problem where cultivation has not been used.

### Perennials

These weeds persist for more than two years and have either fleshy tap roots, e.g., dandelions; or creeping root systems, e.g., Canada thistle (see figure 1). Both root systems store food throughout the season. Fleshy rooted perennials reproduce mainly by seed. Creeping rooted perennials grow in patches and spread both by seed and roots.

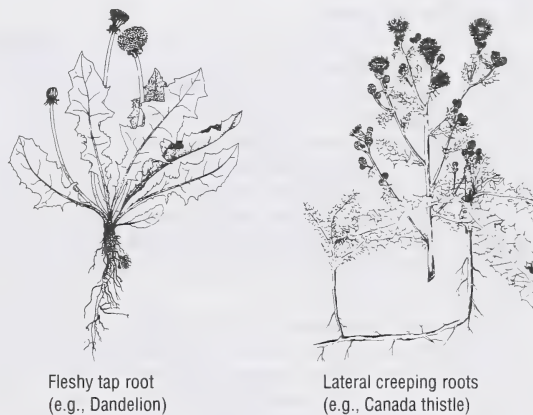


Figure 1. Root systems of perennial weeds.

#### General control recommendations

- *Prevent seed production*
- *Deplete the food reserves in the roots.*

Repeated mowing and/or cultivation may help to achieve control of perennial weeds.

Occasional light tillage will break up and scatter root pieces producing new infestations. Intensive tillage or mowing throughout a season will strain the root energy reserves. Timing of tillage is critical. Because food reserves are generally low from the end of May until mid-July, starting to cultivate or mow at the end of May will cause new shoots to emerge from dormant buds and the stand will appear thicker. This flush of new growth uses more energy than it produces so the overall food reserves are diminished. After three to four weeks, the weed stand should be mowed or tilled again, further depleting the root reserves. Weed control is accomplished by the gradual starving of the root system. Fleshy root perennials like dandelion can also be controlled by tillage. When the top growth is cut off, the root will starve.

## Time of Germination or Emergence

Germination of weed seeds or emergence of perennial shoots is influenced by temperature, moisture, depth of burial and dormancy of the seed. Knowing the date of the expected emergence is helpful in timing cultivation, seeding and spraying.

## Time of Flowering

Knowing the approximate time of year that a weed flowers enables one to control the weed or harvest the crop before viable seed is produced. Viable seeds are produced at varying stages of plant maturity, depending on the species.

## Seed Dormancy

Dormancy is the characteristic of weed seeds that enables them to survive for long periods in the soil without germinating. Weed seeds in the primary dormant state can remain alive in the soil and do not germinate even though adequate temperature and moisture conditions exist. Dormancy is broken naturally by the effects of micro-organisms, alternate freezing and thawing, and drying-wetting cycles. The time seeds remain alive in the soil is called seed longevity. Longevity of weed seeds varies with species. A weed problem will be around as long as its seed can survive in the soil.

Weed seeds remaining in the soil are not the only source of new plants. Top soil, manure or soil around nursery stock that is brought to the home grounds may contain weed seeds, stolons (creeping stems that root at the nodes), rhizomes (underground, rootlike stems) and roots. Weed seeds can also be introduced by wind, run-off water, birds, animals or humans.

## Herbicides

Throughout this section, references to herbicides are made. Bear in mind that even when used according to recommendations, herbicides are not always 100 per cent effective. The action of herbicides depends upon several factors, such as the growth stage of the weed, the temperature at which the herbicides are applied, the fertility of the soil and the amount of available moisture. If it rains or irrigation water is applied within six hours of a herbicide application, the activity of the herbicide may be reduced and re-application may be necessary.

## Weed Control in Lawns

A sound management program to promote vigorous growth of grass will help control weeds. The program should include fertilizing, watering and cutting at the proper height. Herbicides may, nevertheless, be required to keep the lawn free of weeds.

Care should be taken to prevent drift when applying herbicides. Flowering plants and many trees and shrubs are sensitive to herbicides. Precautions that can be taken include use of low pressure or no pressure applicators, application on calm days, covering susceptible plants with newspapers or plastic, and spraying when temperatures are 16 to 25°C. After mowing, allow the grass to grow for about three to five days before spraying. Do not mow for a day after spraying to allow the herbicide to move through the weed.

## New Lawns

Before establishing a lawn by either seeding or sodding, perennial weed problems such as Canada thistle, perennial sow-thistle and quackgrass must be controlled. Weed seed germination should be promoted and the young weed seedlings destroyed with shallow cultivation to reduce weed problems later. Precautions should be taken to prevent reinfestation from contaminated lawn seed and weeds in sod or topsoil. Canada No. 1 seed may contain a certain percentage of weed seeds, but premium quality grass seed contains fewer. When buying premium quality seed, you can specify that it be free of a particular weed.

The following steps can be taken to control perennial weeds before establishing a lawn:

- *Ensure the topsoil brought into your yard is free of perennial grass rhizomes or root pieces of perennial plants.*
- *Perennial weeds in the area to be seeded or sodded can be controlled by treatment with non-selective herbicides containing the active ingredients glyphosate or amitrole. Rotovate about two weeks after treatment, then seed or place your sod.*

New lawns can be sprayed with selective herbicides after the second cutting unless otherwise stated. Selective herbicides such as 2,4-D will kill certain weeds without damaging the lawn. In contrast, non-selective herbicides such as those containing amitrole or glyphosate will destroy all vegetation including the lawn and weeds.

## Established Lawns

Selective herbicides are able to control most broad-leaved weeds in established lawns. However, because of the wide range of susceptibility of the many different weeds found growing in lawns, the correct selective herbicide or mixture

of herbicides must be chosen. See the specific weed section for details on each weed species and its control.

Herbicides are commercially available in different formulations; check the instructions carefully to determine the proper application rate. In most cases, the timing of the herbicide application is critical for obtaining maximum performance. As a rule, early spring applications are best because the weeds are young and more susceptible to the spray. Once the weeds have flowered, they are difficult to control with herbicides.

For safety sake, keep children or pets off the lawn for 48 hours after treatment with these selective herbicides (24 hours after watering or rain). A granular formulation of herbicides will minimize the risk of human exposure. Alternatively, the risk of accidental human exposure will be reduced after you water your lawn. However, irrigation should be delayed for four to six hours after application of herbicides to avoid decreased efficacy.

## Special Problems

**White Clover** is a common perennial that often grows in lawns where grass is weakened. This perennial is drought tolerant and has the ability to grow in compacted soil. The white or pinkish flowers are erect at first but become almost horizontal as they mature. Many home owners regard clover as a weed because it stains clothes and shoes and its sweet scent attracts bees to the yard. Mow at 4 cm. Closer mowing will promote clover growth. Herbicide mixtures containing the active ingredient mecoprop will give good control of white clover. This herbicide application should be done in early spring before the plants flower or harden-off.

**Mosses** thrive in conditions unfavorable for grass growth. Moss growing in the lawn indicates low fertility, poor drainage and excessive shade. The conditions limiting grass growth must be corrected before permanent control of moss can be achieved. Aerate compacted soil, use fertilizers, improve drainage, reduce shade or substitute ground cover plants for grass in low shady places. Early raking to remove moss, then fertilizing to increase grass growth will help in eliminating this problem. Lawn moss-killers will only give temporary control.

**Mushrooms** growing singly or in groups called "fairy rings" are found in lawns and occasionally in gardens. Their growth is a consequence of a specific fungus growing on rotting thatch in the soil. The turf inside of the "fairy rings" will gradually become thin, turn yellow and die because the fairy ring infested thatch prevents water entering the soil. To control or minimize its effect, punch 25 cm deep holes through the turf with a garden fork and follow with heavy water applications at one or two day intervals for a month. Correct fertilization also helps. The other option is to completely remove the fairy ring and resod or seed.

## Weed Control in Gardens

The two general methods of controlling weeds in the vegetable garden are cultural control, such as hoeing and mulching, and the use of herbicides. Cultural control of weeds is a practical approach for the home gardener. Gardeners may not be prepared to cope with the problems associated with applying herbicides in the home garden. For example, home gardeners usually grow several kinds of vegetables and these will likely require different herbicides. Also, some herbicides may leave residues that can injure different vegetables grown in that area the next year. Applying the correct rate of herbicide on a small scale without proper equipment is also difficult.

Gardeners who feel that the use of herbicides is not appropriate or practical for their home garden should rely on cultural methods of weed control such as mulching and hoeing or cultivation.

## Cultural Control

**Mulches** are any materials applied to the soil surface for protection or improvement of the area covered. Mulches with organic material such as grass clippings or weedfree straw, 7 to 10 cm thick, will retard weed development, conserve moisture and help to maintain a uniform soil temperature. After the crop is removed, the mulch layer can be incorporated into the soil and enhance its organic matter content.

Plastic mulches, either black or white, and fabric mulches increase the soil temperature and conserve moisture. Black plastic or fabric mulches, with openings for the crop, will prevent weed growth except where the opening occurs. Clear plastic, however, permits weed growth since light can penetrate through the plastic. Plastic mulches are best suited for warm season vegetables.

**Hoeing or cultivation** should be carried out when weeds are small and the soil surface is dry. After hoeing, most annual weeds can be left on the surface; however, succulent weeds such as purslane and chickweed must be removed. These weeds will re-establish if plant fragments are left on the soil surface. Cultivation should be shallow so that the root systems of garden annuals are not damaged to keep the number of new weed seeds brought to the soil surface at a minimum.

## Herbicides

Control of weeds with herbicides, while not practical for the small home garden, can be useful for large gardens (2,000 m<sup>2</sup> or greater). A herbicide that can be used on a wide variety of vegetable crops is a product containing the active ingredient trifluralin. This herbicide must be incorporated

thoroughly into the top 7 to 10 cm of soil. For uniform treatment, the crops that are tolerant to this herbicide should be located in one area. Trifluralin controls green foxtail, chickweed, lamb's-quarters, pigweed, purslane and some other weeds.

Trifluralin can be used on beans, (dry and snap), cabbage (direct seeded or transplants), carrots, rutabagas, sunflowers, cauliflower (direct seeded or transplants), peas, and transplants of tomato, pepper, broccoli, Brussels sprouts and some annual flowers. Trifluralin is available in small containers for home use, e.g., Co-op Weed Preventer (1.47% granules).

Quackgrass and perennial thistles can be controlled according to recommendations found in the weed section to maximize control. The affected area may have to be left out of production for at least part of the year. For information on application rates and soil incorporation, consult the appropriate herbicide label.

## Weed Control Around Trees, Shrubs and Flowers

Herbicides can be used to control annual weeds, reducing the amount of hand weeding required. Chloramben can be used to control barnyard grass, green and yellow foxtail, chickweed, lamb's-quarters, pigweed, purslane, ragweed and annual smartweed species. It can be used in perennial flowers, shrubs and trees, transplanted annual flowers and certain vegetables. Apply to bare soil or after tilling or hoeing. Do not disturb treated soil. Avoid application to foliage of desirable plants and do not apply when soil is wet. Refer to the label for rates for specific situations.

Rainfall after application will improve control. If no rain falls within three to four days after application, water the area to activate the herbicide. If water is not available, shallow cultivation may be necessary. Weeds are controlled as they begin to emerge. Control can be expected for six to eight weeks after application depending on the weather.

Trifluralin will control barnyard grass, green and yellow foxtail, chickweed, knotweed, pigweed, lamb's-quarters and annual smartweed species around ornamental shrubs, trees and flowers. Apply product before weeds emerge; weeds already growing will not be controlled. Soil to be treated should be loose and free of clods. Apply by shaking container over the area at the appropriate rate. Incorporate into the top 2 cm of soil by hand raking and water lightly. For best results, apply in the spring. For annual flowers, apply only after they become established (about two weeks after transplanting). Use only around ornamentals, shrubs and other established plants that are not used for food.

Herbicides containing the active ingredient paraquat and/or diquat will control top growth of all weeds. These products can be used around ornamental shrubs and trees,

however, the spray must not contact green bark or foliage. Further treatment will be required for regrowth of perennial weeds, because the initial application will not destroy them. There is no residual effect, because clay particles of the soil inactivate the herbicide.

## General Vegetation Control

### Driveways, Patios and Fencelines

Cultural control methods may be tedious but prove safest for vegetation control in areas such as driveways, walks, under fences, backlanes, parking areas, tennis courts and patios. However, herbicides are available that are specifically designed for complete vegetation control in these areas.

Herbicides containing paraquat kill annual weeds and top growth of perennial weeds. These contact herbicides burn off the treated foliage but do not move into the root system. Other products containing glyphosate and amitrole can be used to eradicate most perennial weeds, although repeated applications may be required for some species. These chemicals are safe to use on slopes or around trees and shrubs, provided sprays are kept off foliage and green bark. Glyphosate and amitrole are systemic herbicides that move throughout the plant, when sprayed on the foliage. Therefore, they will give effective control of perennial weeds.

Topgun, an organic, non-selective herbicide can be used around driveways, walks and patios. It kills annual weeds and top growth of perennial weeds. Because Topgun is a non-selective herbicide, precautions must be taken to protect desired vegetation. Topgun is non-residual and will not move through the soil to injure nearby plants. Treated areas can be seeded three days after application of the herbicide.

Soil sterilants are total vegetation control products that act in the soil, killing all existing vegetation and preventing any plant growth for one or more years. This extended weed control is due to the herbicide residue that remains in the soil after application.

Please review the product label carefully. Label directions of sterilants for use around the home caution against applications near desirable plants. These products have resulted in damage to vegetation on neighboring properties.

- *Soil sterilants should be used where the objective is to have bare ground, and should not have wide use around the home.*
- *Strictly follow label directions when using soil sterilants.*
- *Roots of trees and shrubs extend laterally to approximately twice their height. Accordingly, leave a "safety zone" between the treated area and nearby trees or shrubs to prevent root uptake of the soil sterilant.*
- *Do not apply soil sterilant chemicals on sloped areas where run-off water will carry the treated soil into areas where desirable plants are growing or may later be planted.*

## Killing Unwanted Trees

In urban areas, unwanted trees should be manually removed, because they cannot be sprayed safely. After the main stem has been removed, deciduous trees will normally resprout vigorously from the base and may also sucker profusely (e.g., poplar). After the tree has been felled, another cut to reduce the stump height to a minimum would be useful to minimize interference with mowing or other operations. The options for stump removal appear to be limited to natural decay or removal by mechanical means.

To kill the remaining stump, drill holes about 1 cm in diameter in the stump, fill these holes with 2,4-D and close with a plug of clay. Some formulations of 2,4-D may be more effective than others and repeat treatments may be necessary. The herbicide will move into the root system and kill suckers as they develop. CAUTION: Damage may occur to nearby trees, particularly those of the same species, if root intertwining has taken place.

Once the stump is killed, it can be left to the elements and natural decay-causing organisms will gradually break it down.

# Weed Control

## PERENNIAL WEEDS

### Canada Thistle

#### Description

This broad-leaved weed reproduces by horizontal roots and seeds. Shoots from horizontal roots appear on the soil surface in mid April and continue to emerge through the summer. Shoots grow to 1.5 m and are extremely competitive. Flowering occurs from June to late autumn in gardens, undisturbed sites and is not likely to occur in lawns.

#### Control

**Cultural** – Root starvation is the key to controlling Canada thistle and can be accomplished through repeated tillage, mowing or hand pulling. Increasing the competitiveness of the lawn or crop will assist in minimizing this weed problem.

**Herbicide** – Products containing 2,4-D, MCPA or dicamba will control thistle. Refer to the label for appropriate rates. Non-selective herbicides containing the active ingredient glyphosate or amitrole will also do an effective job of controlling Canada thistle in non-crop areas.



### Creeping Charlie

#### Description

This attractive broad-leaved creeping perennial has a square stem that produces roots at the nodes. This low stature plant produces blue-purple flowers from late spring through autumn. It forms dense mats in gardens and lawns, excluding all other plants.

#### Control

**Cultural** – Hand pulling is not an effective way to control this weed. Continuous cultivation helps reduce its growth in gardens. If the problem is severe in lawns, digging out the infestation and reseeding will enhance control.

**Herbicide** – It can be controlled in lawns with selective herbicides containing the active ingredient dicamba. Repeated application may be necessary.



### Dandelion

#### Description

Reproduction is mainly by seed. New plants, however, can develop from the tap root. This broad-leaved weed can pose a problem throughout the season, but is most abundant in the spring. The bright yellow flowers can appear in early spring to late fall. This weed occurs mostly in lawns and undisturbed waste areas.

#### Control

**Cultural** – Dandelion cannot tolerate tillage, so it should not pose a problem in vegetable gardens. In lawns, the best approach is to increase the vigor of the grass. Mowing is not an effective method of control.

**Herbicide** – Any herbicide containing the active ingredient 2,4-D, MCPA or dicamba will control dandelions. Treat for dandelions preferably in early fall (late August to mid-September) or in early spring before flowering (early to mid-May).



## Foxtail Barley

### Description

This short-lived perennial grass spreads by seed only. It is an erect bunch grass. The key distinguishing characteristic is a long feathery seed head. It grows on undisturbed sites, roadsides and driveways.

### Control

**Cultural** – Mowing will prevent seed production and weaken the plant but will not get rid of this weed. Tillage is the best method for control.

**Herbicide** – None presently available.



## Plantain

### Description

This broad-leaved perennial has a short vertical root and many slender lateral roots. The leaves are distinct large and oval and lie close to the soil surface. The inconspicuous flowers are crowded on slender spikes. This weed appears from spring to late fall mostly in waste places, lawns and gardens.

### Control

**Cultural** – The thick tenacious rootstock makes hand pulling in gardens difficult. Timely hoeing in the garden and mowing the lawn from July to September reduces seed production. This weed cannot compete effectively with a vigorous lawn, so maintaining a good grass stand is important in preventing this weed from establishing.

**Herbicide** – Plantain can be controlled in lawns with 2,4-D or 2,4-D mixtures. Spot treatment throughout the season will aid in its control. This weed is resistant to the active ingredient dicamba.



## Purple Loosestrife

### Description

This attractive perennial weed has square stems with lance-shaped leaves. It grows to a height of 1 to 3 metres. It is easy to identify by its bright pink/purple flowering spikes that bloom from mid-July through September. A mature plant can produce 2.5 million seeds annually. Purple loosestrife spreads primarily by seed, but will regenerate from roots and stems. The plant aggressively invades wetland areas, eliminating native plants and wildlife.

### Control

**Cultural** – Clipping seedheads or hand-pulling during initial flowering stage will stop the reproductive cycle. Plant parts should be sealed in a plastic bag for normal disposal at a landfill site. Purple loosestrife should not be composted. Areas where control campaigns are begun must be revisited for several years to remove any regrowth from undetected roots or new seedlings.

**Herbicide** – No herbicide is presently registered for the control of this weed.



## Quackgrass

### Description

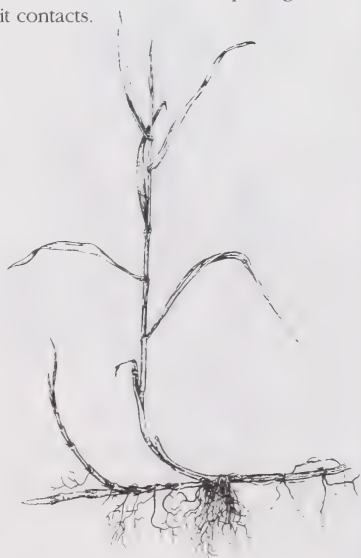
This weed is a perennial grass spreading mainly by underground rhizomes and by seed. Shoot growth appears early in the season from underground stems called rhizomes. If cut, the underground stems can produce new shoots and new infestations can develop. Flower heads appear generally from late July through to freeze-up. Quackgrass is an extremely aggressive weed and can establish itself in lawns, gardens, and flower beds.

### Control

**Cultural** – Hoeing, hand pulling and mowing remove only the top growth. To eliminate this weed the rhizomes must be removed. In lawns, frequent mowing to 4 to 5 cm in height will help to suppress quackgrass but not eliminate it.

**Herbicide** – Any herbicide containing the active ingredient glyphosate will control quackgrass effectively.

Best performance will be seen if this weed is sprayed before flowering. Caution should be exercised when using this herbicide because it is non-selective and kills all plant growth it contacts.



## Scentless Chamomile

### Description

This attractive weed has the unusual ability to be an annual, biennial, or perennial. It produces daisylike flowers from early spring to late fall. The leaves are feathery - the key to distinguishing this weed from other daisylike plants. This troublesome weed grows in undisturbed sites, roadsides and in gardens. It seriously threatens agriculture in Alberta and should be controlled whenever it is found.

### Control

**Cultural** – Hand pulling, hoeing and tillage are the only effective means of cultural control. Mowing will not completely control this weed. These cultural control methods should be performed prior to flowering wherever possible.

**Herbicide** – No herbicide is presently registered for domestic use for control of this weed.



## Toadflax

### Description

This attractive perennial weed spreads by seed and by creeping roots. New shoots and seedlings emerge throughout the season beginning in midspring. This competitive weed produces yellow snapdragon-like flowers from June until fall. Toadflax is commonly found on roadsides, waste places and uncultivated areas.

### Control

**Cultural** – Mowing or hand pulling every three to four weeks beginning in June will bring toadflax under control but will not eliminate it completely.

**Herbicide** – The active ingredient glyphosate at higher rates will effectively control toadflax. Repeated treatment may be necessary for complete control. Because this is a non-selective herbicide, it should not be used in lawns or any area where other growth will be exposed.



# Weed Control

## ANNUAL WEEDS

### Chickweed

#### Description

This low-lying annual can root from the stem nodes making it a particularly troublesome weed. The leaves are opposite, oval in shape and pointed at the tip. The 10-point, star-shaped white flowers are produced throughout the growing season. It often grows where soil is compacted and in moist, shady areas. Chickweed is common in lawns and gardens.

#### Control

**Cultural** – Remove the entire plant if hand pulling or hoeing because it can re-establish itself especially under moist conditions. Removing shade where possible will assist in minimizing this problem.

**Herbicide** – In lawns, a late spring application of selective mecoprop + 2,4-D will effectively control this weed.



### Common Groundsel

#### Description

This annual is hollow-stemmed with alternate leaves that are lobed or toothed and fleshy. Flowers are bright yellow and appear from late spring to late fall. It is an abundant weed that is found in lawns, gardens and wherever the soil has been disturbed.

#### Control

**Cultural** – Groundsel is readily controlled in gardens by hoeing or tillage, especially before the seeds mature in the fall.

**Herbicide** – In lawns, control can be achieved with selective herbicide mixtures containing mecoprop + 2,4-D + dicamba applied in the spring.



### Lamb's-quarters

#### Description

This annual weed is variable in its characteristic. Generally the leaves are stalked and triangular. The key to its identifications is the undersurface of the leaves are greyish green and covered with powdery or mealy particles. The flowers are small, green and lack petals. This weed is common in garden and on roadsides.

#### Control

**Cultural** – This weed is easily controlled by hoeing, mowing, or tillage. Subsequent emergence of lamb's-quarters may occur throughout the season.

**Herbicide** – Any product containing the active ingredient 2,4-D will control this broad-leaved weed.



## Pineapple Weed

### Description

This annual is low growing with many branches of finely divided leaves. The distinct flower head is yellowish-green and cone-shaped, located at the end of the branches. When crushed the plant emits a pineapple odor. This weed is found along edges of lawns and in gardens.

### Control

**Cultural** – Keep edges between lawns and driveways well trimmed. It can be controlled in the garden by hoeing or tillage.

**Herbicide** – Selective herbicides containing 2,4-D or MCPA will effectively control this weed.



## Prostrate Knotweed

### Description

This annual broad-leaved weed has prostrate wiry stems with small leaves that have a papery sheath at the joint where the leaf joins the stem. The small flowers are pinkish or white and are formed in the sheaths. This weed thrives on the hard dry soil of foot paths and driveways. It also occurs along roadsides, gardens and cultivated fields. Birds often feed on its seed.

### Control

**Cultural** – Aerate compacted areas and stimulate grass growth in lawn. Hand pulling, hoeing and tillage are effective. Because of its low growth habit, mowing will not control this weed.

**Herbicide** – Selective herbicides containing 2,4-D + dicamba + mecoprop will control knotweed. For best results weeds should be sprayed in the seedling stage.



## Purslane

### Description

This low growing annual weed reproduces only by seed. It has succulent reddish stems and thick green leaves. The reddish stems often grow a foot or more in length. The yellow flowers are borne in small clusters at the end of stems and in the axils of leaves. It is particularly troublesome in lawns and gardens.

### Control

**Cultural** – Purslane will continue to flower even after it has been uprooted or hoed. Always remove the plants since cut pieces can root and continue to produce seed.

**Herbicide** – Products containing MCPA will effectively control this weed in the seedling stage.



## Round-leaved Mallow

### Description

This annual broad-leaved weed has a large taproot and reproduces by seed only. Stems are trailing and/or erect with round wavy-edged leaves. The tiny white flowers are in the leaf axils. The distinctive fruit contains orangelike segments. This weed is frequently found in lawns, gardens, barnyards and roadsides.

### Control

**Cultural** – Once this weed is established it is difficult to control. Hand pulling may be difficult due to the taproot; however, it is the best method of control. Hoeing and tillage of the seedlings is also effective. Because of its low growth habit, mowing is not likely to be effective.

**Herbicide** – It can be controlled in lawns with repeated application of the herbicide mixtures containing dicamba, + 2,4-D + mecoprop.



## Shepherd's Purse

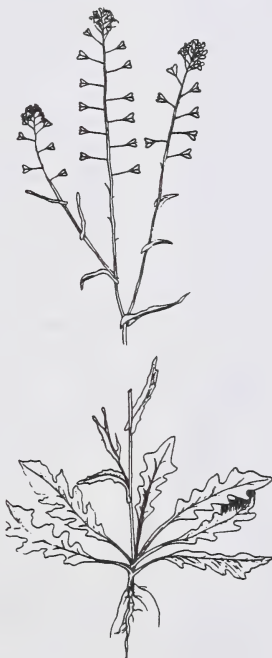
### Description

Shepherd's purse can behave as an annual or winter annual. It has a solid deep taproot and a rosette of leaves that lie flat on the ground. The leaves are elongated and deeply lobed. Many small, white flowers are produced on a stem. The seed pod has a distinctive heart shape. This weed is commonly found in lawns and gardens.

### Control

**Cultural** – Fall hoeing will destroy the rosettes and prevent early ripening the following summer. Cultivation and hoeing are effective control methods.

**Herbicide** – Apply 2,4-D or MCPA when the weeds are in the seedling or rosette stage in early spring or fall.



## Stinkweed

### Description

Stinkweed is an annual or winter annual plant, which possesses a tap root. The lower leaves form a rosette on the soil surface. The leaves may be slightly toothed. The flowers are numerous, small and white. This weed reproduces only by seed. Seed pods are flat and rounded with a narrow deep notch at the tip. The whole plant has a sour turnip-garlic odor. This weed occurs in cultivated fields, roadsides, gardens and waste places.

### Control

**Cultural** – Tillage and hoeing will eliminate this weed. Continued emergence may occur during the entire growing season, so these operations may have to be repeated.

**Herbicide** – Any selective herbicide containing the active ingredients 2,4-D or MCPA will control this weed effectively. For best results, spray before the stinkweed flowers.



### Introduction

Any plant in an unhealthy condition is said to be diseased. Infectious or parasitic diseases are caused by micro-organisms that live off the host plant to the detriment of the host. Infections can be caused by bacteria, fungi, nematodes, viruses or other micro-organisms. Diseases can also be caused by non-infectious agents.

Bacteria are single-celled and can multiply rapidly. They enter plants through wounds or natural plant openings because they cannot actively penetrate the plant cuticle. Insects are often important in spreading bacteria.

Fungi vary in size from microscopic to large structures like the mushroom. They reproduce by spores. Single spores are invisible to the naked eye and can be spread over great distances by wind, water, insects, man, tools and vehicles. Fungi and nematodes can survive for many years in soil and plant residue. Parasitic fungi may also live for many years inside a plant before killing it.

Viruses are invisible except to powerful electron microscopes. They cannot multiply outside a living cell. They are spread by insects (aphids and leafhoppers) and man. During cultivation and pruning a virus can be transferred on tools or the hands from a diseased plant to a healthy one.

Thousands of micro-organisms are potentially infectious to plants. Some of the major disease are discussed here.

Not all micro-organisms are pests. Many are essential in food production (bread, wine, beer, cheese, vinegar, etc.) and antibiotics.

Non-infectious diseases are the result of factors such as environmental stress caused by drought, nutrient deficiency (copper, iron), cold temperatures and other climatic factors. Soil salinity problems may produce symptoms similar to those caused by infectious disease organisms.

Herbicides can cause symptoms that may be confused with disease symptoms. Injury from herbicides is difficult to diagnose accurately on the basis of symptoms and usually requires an investigation into the pattern of damage and a history of the types and rates of the chemicals applied.

Insect damage, too, can be mistaken for disease. Since such damage is often noticed only after the insect has left, it is sometimes more important to become familiar with the type of damage an insect causes than with being able to identify the insect. (See the section on insect pests.)

Do not be surprised if the disease symptoms expressed by your plant do not fit any of the disease descriptions given or, on the contrary, if they seem to describe half a dozen diseases. Accurate diagnosis of a disease may require a trained plant pathologist and some special equipment. Luckily, accurate diagnosis of a disease is not always necessary in order to control it.

For practical purposes, it is often possible to talk of diseases and control measures in terms of the general symptoms that are produced (see figure). Although a particular symptom can be caused by a variety of environmental and biological factors, the treatment of these factors involves many of the same cultural practices and controls.

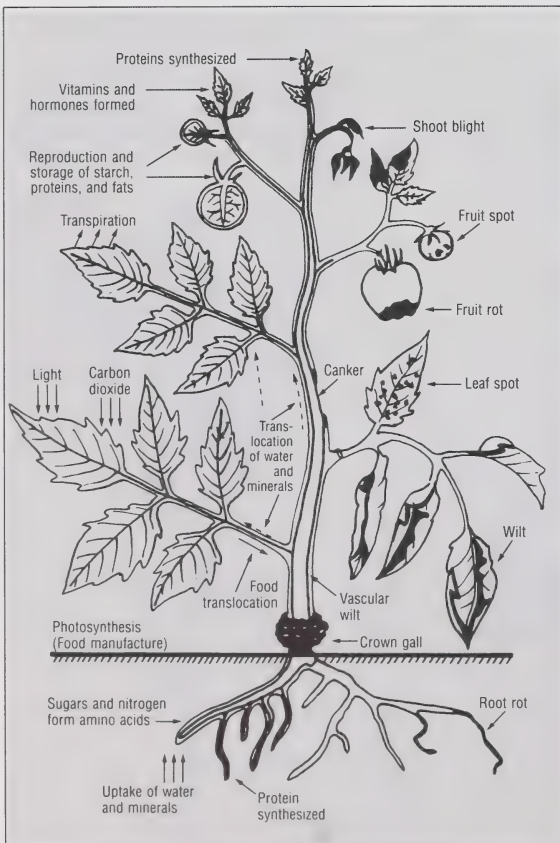


Figure 2. Basic functions in a plant and interference with these functions by some common plant diseases.

# Diseases

## OF VEGETABLES

### Control

Control methods seek to achieve either eradication or prevention. Eradication consists of procedures that stop the development of a disease by destroying the disease micro-organism, whereas prevention is designed to protect plants from infection.

Most controls for plants are preventive and non-specific cultural methods such as pruning, sanitation, watering and fertilizing. Few diseases can or need to be controlled by chemical pesticides. Pruning controls a number of diseases and prevents others from continuing to infect your plants. The healthier your plant, the more resistant it will be to infection by micro-organisms. If your plant does not seem healthy, review your watering, fertilizing and other gardening practices. Experiment with your cultural practices. Too much of a good thing is sometimes as bad as too little. Every plant has to be treated somewhat differently since no two growing sites are exactly the same. Watch your plants and see how they respond to your care and to changes in the weather. Eventually you will come to know exactly what your plants require to be healthy and vigorous.

Growing plants successfully requires knowledge of a plant's growth requirements. Information on plants can be found in books and government publications including the *Alberta Horticultural Guide*. Specific information on growing practices is also often on seed packets.

Practices that improve the vigor of your plants will help your plants resist infection by disease micro-organisms. Obtaining good quality seed is essential in preventing the introduction of a new seed-borne disease into your garden. Good sanitation including disposing of or composting plant residue reduces the buildup of disease micro-organisms in your garden. Rotating your vegetable growing area will also help to reduce the buildup of specific diseases in your garden. Lawn clippings that have not been recently treated with herbicide will improve the tilth of garden soils and can be applied during the growing season.

Disease incidence varies considerably from one area to another and from one garden to the next. Different soil types, site location and cultural practices all contribute to produce a unique situation. Consequently, it is often useful to determine for yourself whether specific control practices are indeed necessary. One way in which this can be done is to apply a particular control procedure (such as application of a pesticide) or a change in cultural practice (watering, fertilizing or cultivating) to half of your planting only. During and after the season, compare the growth or production of plants to the different treatments. Trying different varieties is another good way of determining how best to control diseases and maximize your production. Practising the following preventive methods should mean that you will have few serious disease problems in your garden.

### Prevention

Prevention is the best way to control vegetable diseases. Once a disease is established, chemical control may not be effective. Prevention involves good cultural practices.

Plant disease resistant cultivars if they are available. This information is often found in seed catalogues, on seed packages, or at horticultural supply stores.

Proper soil preparation is important for obtaining good soil drainage. Avoid cultivating wet soil and only plant in warm, moist soil. Use fertilizer and water when necessary. If you are unsure of the fertilizer needs of your vegetables, have your soil analyzed at a soil testing laboratory. Do not try to change the soil pH unless that it is indicated by a soil analysis.

Rotate your vegetables yearly. Although there is no standard rotation, a good starting place is a four-year rotation. This involves dividing your garden (if possible) into four distinct plots. In one plot, plant all of your cole crops (cabbage, cauliflower, broccoli, etc.); in another plant your vine crops (squash, pea, bean, cucumber, etc.); in another, miscellaneous vegetables including onions, beets, carrots and radishes, and finally in your fourth plot, plant your potatoes and tomatoes. Remember, this is only a suggestion and your crop rotation will depend very much on how large your garden is and which vegetables you decide to grow. You may also need to adapt your rotation if you have problems with specific diseases. If land is available, changing the location of your garden is a good way to control many soil-borne diseases. If your potato crop is moved around every year, soil-borne diseases such as scab and rhizoctonia scurf cannot build up to destructive and unsightly levels.

Maintain good sanitation. This involves good weed control, including volunteers (i.e., vegetables that have seeded themselves), turning under or cleaning up crop residue, removing and destroying diseased plants.

Some diseases are favored by dense foliage and a moist environment. To avoid problems do not use heavy seeding rates and high fertilizer levels. Water early in the day so that plants do not remain wet overnight. Avoid long periods of overhead watering, particularly during flowering in crops such as beans and cucumbers.

Control insects that may cause extensive defoliation or root damage that encourages diseases. Early defoliation of tomatoes can expose fruits to sunscald.

Some diseases can be prevented and controlled by chemicals. Fungicides or hot water treated seed may prevent the introduction of some diseases. Seed may also be purchased which is certified disease-free.

Apply an appropriate fungicide if necessary. Check the label for information on which plants the pesticide can be used on and note how many days before harvest the last spray can be made. For details on the timing of application and the application rates, carefully read the product label.

Some fungicides are applied before planting (drenches), while others are applied directly to the vegetables.

Never use the same sprayer for herbicides and then use it for insecticides or fungicides if at all possible. If the same sprayer must be used it should be thoroughly washed and pumped out with hot soapy water. Residues of herbicides left in sprayers may injure desirable plants.

## Harvesting and Storage

Proper harvesting practices are essential if storage problems are to be avoided. Although harvesting practices will vary somewhat for different vegetables, some common methods of avoiding problems are: dig root crops late in the fall when the crops are mature and the soil is cooler; avoid harvesting in wet weather; avoid bruising or skinning the vegetables.

Before storing vegetables in a cool environment, dry them briefly in a cool dark place. Remove damaged or bruised specimens and consume them first. Root crops can be washed to remove soil, but they must be dried before storing.

Sanitation and proper environmental conditions determine the life of your stored vegetables. Storage areas should be cleaned thoroughly with a disinfectant before storing produce.

Onions are often ready to harvest in August. Do not bend down stems to hasten maturity because that provides an entry for neck rot organisms. Instead gently lift plants with a garden fork to break some of the roots. The leaves will fall over naturally if this is done properly. Once harvested, cure the onions in a warm, dry, well ventilated room until the outer skins become papery. Store the cured onions in wooden bins or mesh bags in the coolest storage that you have available.

Potatoes should not be left in the field to dry. Exposure to light causes greening. This green tissue may be poisonous. Store potatoes long-term at 5 to 7°C and 90 to 95 per cent humidity.

Carrots, parsnips, rutabagas and beets should be stored at 0 to 1°C and 95 to 98 per cent humidity.

Empty refrigerators in good working order make excellent vegetable storage places if you lack an indoor or outdoor cold storage facility.

## Blackleg

Crucifers (broccoli, Brussels sprouts, cabbage, cauliflower, rutabaga)

### Description of Damage

Symptoms appear two to three weeks before transplanting. Well-defined, ashen-grey spots occur on the leaves, and similar spots surrounded by a purplish border occur on stems. If large areas of stem tissue are killed, the affected plants will die.

### Summary of Life History

This fungus disease is carried on the seed and persists on plant residues for several years. The disease usually starts in the garden from infected residues (stems, roots) or seed.

### Prevention

- Use good cultural rotation practices.
- Use treated seed.

## Blossom End Rot

Tomato and pepper

### Description of Damage

A water-soaked area forms at or near the bottom of the fruit (blossom end) and later enlarges and darkens. Eventually the cankers become dry, sunken, flat, leathery and finally dark brown to black in tomatoes or light colored and papery in peppers.

### Summary of Life History

An irregular water supply produces a water deficit in the fruit resulting in blossom end rot. Blossom end rot is also associated with an unbalanced nutrient supply, particularly, lack of calcium or excess nitrogen in relation to phosphorus, potassium and other major nutrients.

### Prevention

- Keep evenly watered.
- Use a complete fertilizer with calcium.
- Grow in a well-mulched soil.

## Botrytis Grey Mold

Beans

### Description of Damage

See Botrytis grey mold under "Small Fruits"

### Summary of Life History

See Botrytis grey mold under "Small Fruits"

### Prevention

- See Botrytis grey mold under "Small Fruits"

## Clubroot

Crucifers (broccoli, Brussels sprouts, cabbage, cauliflower, rutabaga)

### Description of Damage

Affected plants show almost normal vigor at first, but then gradually or suddenly pronounced stunting sets in, which may be followed by the death of the plant.

The most obvious symptom appears on the roots and sometimes the underground part of the stem. The symptom consists of knobby club-shaped swellings on the roots and rootlets.

### Summary of Life History

The fungus overwinters in the soil and can remain there indefinitely. Once a garden becomes infested, it is unsuitable for growing plants in the cabbage family unless costly methods and materials are used to sterilize soil or resistant varieties are grown. This disease is rare in Alberta and the rest of the prairies.

### Prevention

- Plant disease resistant cultivars.
- Grow plants in well-drained soil, with a pH of seven or above.

## Common Scab

Potato, carrot, beet

### Description of Damage

Symptoms of the disease are distinct, irregular, rough, corky spots on the tuber or root.

### Summary of Life History

This disease is caused by a bacteria-like organism. It is most damaging in alkaline or freshly manured soils. Uniform watering during tuber or root initiation results in less disease.

### Prevention

- Use good cultural rotation practices.
- Norking and Superior have good scab resistance. Russet Burbank (gem) and Norland have intermediate resistance. Most other potato varieties are susceptible.
- Disfigured roots or tubers are perfectly edible, they just don't look good.

## Damping-off/Seedling Blight

All vegetables

### Description of Damage

Seedlings either fail to emerge or become stunted and collapse before the first leaves unfold. Some plants survive but carry a scar known as "wirestem" near the soil line.

### Summary of Life History

Various fungi, capable of thriving in a wide range of conditions, can cause damping-off. In general, conditions that are sub-optimal for plant growth such as wet or cold soil favor these fungi.

### Preventive

- Use good cultural practices.
- Avoid overwatering.
- Use treated seed.
- Grow in sterilized soil in pots or trays.

### Chemical

- Use captan or thiram.

## Herbicide Injury

Most vegetables

### Description of Damage

Many vegetables are susceptible to 2,4-D injury. The first symptom is a downward curvature of the leaves and the tips of the growing points. In severe cases, stems become thick, stiff and brittle and show a whitening of the external surface and severe curvature and twisting of leaves. New leaves do not expand fully and are elongated with abnormally pointed tips. Picloram and dicamba are soil residual herbicides that can cause a "fiddlehead" type symptom on tomatoes and potatoes.

### Summary of Life History

Herbicide sprays may drift from their intended area of use such as lawns and onto gardens. Residual herbicides may have been in the soil from a previous year's application, causing damage to garden plants.

### Prevention

- Avoid using herbicides in and around the vegetable garden.
- Do not use herbicide-treated lawn grass as a mulch.
- Avoid bringing in soil or farmyard manure from unverified sources.

## Leaf Spots and Blights

All vegetables

### Description of Damage

Leaf spots cover a limited area of the leaf or stem; whereas blight is characterized by general and rapid killing of leaves, flowers and stems. A powdery white growth is sometimes associated with leaf spots.

### Summary of Life History

Bacteria and fungi are responsible for causing these symptoms. Leaf spots are rarely severe enough in Alberta to warrant control measures. However, some blights and leaf spots can cause extensive damage, especially if moist weather prevails. These diseases overwinter in crop residues.

### Prevention

- Use good cultural practices.
- Avoid overwatering.

## Neck Rot

Onion

### Description of Damage

The tissue about the neck of the onion may become sunken and have a dried-out appearance. A grey mold with many black kernel-like bodies may appear about the neck of the onion or cover most of the surface.

Inner scales are soft, rotten and have a light-brownish color.

### Summary of Life History

Neck rot is principally a storage disease and seldom attacks onion bulbs while they are still in the ground. The fungus that causes neck rot overwinters in plant residue, soil and buildings that have stored diseased onions.

### Prevention

- See harvesting and storage detailed earlier in this section.

## Potato Greening and Glycoalkaloids

Potato

### Description of Damage

The skin and flesh of tubers turn green when exposed to light over a period of time. Glycoalkaloids are naturally occurring in potatoes and increase in tubers that are exposed to light. Glycoalkaloids may also build up if the foliage is subject to severe insect damage, e.g., Colorado beetles or tuber flea beetles.

### Summary of Life History

High glycoalkaloid levels may be harmful to humans. Peeling removes most of the glycoalkaloids unless the potatoes have been stored for some time, thus allowing the glycoalkaloids to spread toward the centre of the tuber.

### Prevention

- Avoid exposing tubers to light, more than is absolutely necessary for harvest and storage.

## Powdery Mildew

Most vegetables

### Description of Damage

See Powdery mildew under "Small Fruits"

### Summary of Life History

See Powdery mildew under "Small Fruits"

### Prevention

- See Powdery mildew under "Small Fruits"

## Rot

Most vegetables

### Description of Damage

Rot consists of softening, discoloration and often disintegration of plant tissue.

### Summary of Life History

These symptoms are produced by many of the same organisms that are responsible for causing leaf spots and blights. Excessive sunlight or wide fluctuations in soil moisture can also result in fruit rot.

### Prevention

- See leaf spots and blight.

## Storage Problems

All stored vegetables

### Description of Damage

Various fungi, bacteria and environmental factors can cause problems with stored vegetables. Symptoms range from rotting vegetable tissue to an abundance of fluffy white, brown, grey or pink fungus growth.

### Summary of Life History

Storage vegetables are often infected in the field and the disease progresses in storage. Relatively warm and humid storages promote the development of storage diseases.

### Prevention

- See harvesting and storage detailed earlier in this section.

## Sunscald

Tomato, pepper

### Description of Damage

A light-colored area develops on the side of the fruit exposed to the sun. These areas become slightly sunken or wrinkled and creamy white on older fruit. Spots appear light brown on young fruit. Scalded tissues dry out rapidly in hot weather and become thin and papery.

### Summary of Life History

This disease is caused by high temperatures at the fruit surface as a result of exposure of the fruit to direct sunlight.

### Prevention

- Do not remove all leaves around the fruit.

## Tipburn

Lettuce

### Description of Damage

The first symptoms are small, brown spots about 0.6 cm from the edge of the leaf. The tissue around these spots often dies and turns brown. Tipburn may also occur internally. Such dead areas within the head offer excellent places for rot-producing organisms to become established, especially certain bacteria that cause a watery tissue breakdown commonly known as "slime rot".

### Summary of Life History

This disease is caused by environmental factors.

Conditions that increase the incidence and severity of the disease are:

- rapidly growing, succulent plants,
- high humidity, as well as high temperatures,
- fluctuating or inadequate soil moisture and
- calcium and/or boron deficiencies.

### Prevention

- Plant disease-resistant cultivars.
- Use good cultural practices.

## Viruses

Most vegetables

### Description of Damage

The most common and sometimes the only symptom produced is reduced growth of the plant, resulting in various degrees of dwarfing or stunting of the plant particularly in potatoes, cucumbers and squash. Viruses can cause a variety of symptoms ranging from ringspots and mosaics to tumors and distortion of stems and leaves. (See Viruses under "Small Fruits" for a more detailed description of virus symptoms).

### Summary of Life History

Viruses are spread by contact of diseased plants with healthy ones as might happen, for instance, directly by vegetative propagation, or indirectly by means of gardening tools, your hands or by the feeding habits of insects or other pests. Once a plant is infected, there are no chemicals that will eliminate the virus. It is therefore important to obtain seed or tubers that are certified virus-free. Lettuce and beans are prone to seed-borne virus diseases.

### Prevention

- Use good cultural practices.

## White Rot

Onion, Welsh onion, garlic, leek, shallot

### Description of Damage

The leaves of an infected plant decay at the base, turn yellow, wilt and fall over, the older ones being the first to collapse. The roots of such plants usually are badly rotted. Black kernel-like bodies about 0.5 cm in diameter are formed throughout the onion.

### Summary of Life History

The white rot fungus persists in the soil for many years. It is spread by running water or carried in soil clinging to transported seedlings, sets or tools. The disease is most severe in cool, fairly moist soil.

### Prevention

- Plant disease-resistant cultivars.
- Practise crop rotation and good sanitation.
- Examine sets for disease and cull.

## Wilts

All vegetables

### Description of Damage

Wilt is generally caused by insufficient water. Certain disease organisms cause this condition by interrupting the regular flow of water. Fungal wilts are characterized by discolored brown areas on infected stems and twigs. Bacterial wilt can usually be identified by the presence of a sticky substance in the stem tissues.

### Summary of Life History

Wilts can be caused by bacteria, fungi, viruses or environmental factors. Wilt organisms may overwinter in plant residues, in the seed, in vegetative propagative material or in insects. They enter plants through wounds and are spread by infested soil, by direct contact of plants or by insects.

### Prevention

- Use good cultural practices.
- Use treated seed (captan or thiram).

# Diseases

## OF GARDEN FLOWERS

### Black Spot

Roses

#### Description of Damage

Round black spots with fringed margins develop on the leaves, stems and leaf stalks. Spots enlarge, slowly developing a yellow zone around the spots. Entire leaves will yellow and fall prematurely. Severely infected plants may lose most of their leaves.

#### Summary of Life History

Disease is caused by a fungus that overwinters on stems and infected leaf residue. Fungus becomes active during warm wet weather in the late spring and summer. Within two weeks of a spot appearing, spores are produced and the infection is carried by rain or water to other leaves.

#### Cultural

Plant disease-free roses in a sunny area with good ventilation and soil drainage. Destroy all fallen leaves from infected plants. Stems should be pruned back severely, within 5 to 8 cm of the graft union and destroyed in late fall.

#### Chemical

Spray applications are more effective than dusts. Use benomyl, captan, sulphur, chlorothalonil, diclone or folpet.

### Botrytis

Peony, lily and other perennials

#### Description of Damage

Young stalks suddenly wilt and fall over. Buds turn black and dry up. Opening flowers may be destroyed. Leaf spots may develop when infected petals fall on foliage. In wet weather the diseased parts become covered with a grey-brown felty coat of spores.

#### Summary of Life History

The fungus overwinters at the base of infected stalks or infected leaf residue. Plants become infected from spores that are spread by wind or rain.

#### Cultural

Sanitation is the most important step in control. Destroy diseased plant parts immediately. Remove tops just below ground level in the fall and dispose. Avoid dense plantings and overhead watering. Grow in open well-drained areas of the garden.

#### Chemical

Apply zineb, sulphur, benomyl or combinations of these at 7 to 10 day intervals as soon as shoot growth appears in early spring.

### Powdery Mildew

Annuals, perennials and roses

#### Description of Damage

Disease starts on young leaves as raised, blister-like areas that are soon covered with a greyish-white powder or talcum-like mold. The fungus growth develops on the surfaces of leaves, stems, buds and flowers. The fungus feeds only on the plant's surface and slowly injures the plant. Symptoms of injury are: stunting, distortion of leaves and buds, yellowing of leaves, premature leaf fall and a general decline in plant growth.

#### Summary of Life History

Fungi overwinter on diseased plant residue, stems and dormant buds. Spores are dispersed by wind and rain. Mildew is favored by humid conditions with widely fluctuating temperatures. It is most common in crowded plantings where air circulation is poor.

#### Cultural

Grow mildew-tolerant or resistant cultivars wherever possible. Avoid planting in shady locations. Space plants out to avoid overcrowding and allow air circulation.

#### Chemical

Apply protective fungicides at first sign of infection. Use dinocap, benomyl, sulphur, folpet or tribasic copper sulphate.

See use of bicarbonate of soda under powdery mildew of small fruits. Try it out first on a few plants.

### Wilts

Aster, sweat pea

#### Description of Damage

Young and old plants may suddenly wilt and die.

#### Summary of Life History

The wilt is caused by seed and soil-borne fungi (usually a *Fusarium* fungus).

#### Cultural

Do not plant in soil where this problem has occurred because the fungus will live indefinitely in infested soil. Buy wilt resistant strains. Do not spread soil from infested to healthy areas.

# Diseases

## OF ORNAMENTAL AND FRUIT TREES

Diseases can be reduced by preventing environmental stress. Proper tree maintenance prevents the development of many diseases and can be accomplished by following these three steps:

### Match the Tree or Shrub to the Site

The choice of plant material depends on what requirements must be met. For example, plants might need to be salt and drought tolerant, be easily maintained, be colorful or a combination of these factors. Determine your selection guidelines.

After establishing guidelines, determine what plants are available that fit your needs. The *Alberta Horticultural Guide*, available from the Publishing Branch of Alberta Agriculture, Food and Rural Development, is an excellent source of information on tree characteristics and cultural practices.

### Maintain Tree Health

Newly planted trees should be kept uniformly moist throughout their first growing season. Once your trees are established, water them during periods of low rainfall. Evergreen trees and shrubs should also be watered before freeze-up in late October to help prevent winter drought injury. Watering should also be done if warm weather occurs during the winter causing the soil to become dry next to building foundations. When you are watering, always use enough water to soak the soil properly. Do not water a small amount each day because this encourages shallow rooting, which makes the trees susceptible to future droughts and frost damage.

Trees should be lightly fertilized every spring. Inadequate fertilization can result in yellowing foliage, small leaves and winter injury. Most good lawn fertilizers with a high nitrogen content (10-8-6, 10-6-4 or 16-20-0) are acceptable for trees. Application of fertilizers after July 15 should be avoided since this will promote succulent growth that will not mature soon enough and may be damaged by freezing.

Pruning helps keep trees symmetrical and healthy. Flowering trees need pruning more often to let light and air into them to encourage healthy growth and blooming. Your local nursery, garden supply centre, library or university extension service have many useful hints or publications or courses on this subject.

### Avoid Changes in the Growing Site

A delicate balance exists between the root systems of a plant and its soil environment. Site changes such as building construction usually result in root damage of nearby trees. This will weaken the tree and make it more susceptible to attack by insects and disease organisms. Your tree gradually will lose vigor and may show discoloration, small leaves, poor growth, early leaf drop and dieback of twigs and branches. This condition usually progresses over several years. To prevent the decline of your plant, prune away dead wood. This will reduce the crown size and promote new growth. And don't forget to water and fertilize.

## Prevention

- a. Avoid selecting susceptible varieties or species when planning new plantings. Garden centres have this information.
- b. At pruning time, and this will vary for different trees and shrubs, several practices should be followed to help prevent your tree from being infected by disease. It is important that sprouts from the base of a tree, and water shoots on the trunk and larger limbs be removed since they can easily be infected. Pruning paints are not recommended or necessary. When pruning, properly and repeatedly disinfect shears with a solution such as lysol<sup>®</sup> (50 ml per litre of water) or household bleach (100 ml per litre of water). Always work on healthy looking trees and branches first.
- c. Maintain the vigor of susceptible trees by proper fertilization and regular watering. Avoid excessive use of high nitrogen fertilizers, which promote soft susceptible growth. Control wood and shoot boring insects that may be stressing your trees. Water after leaf drop but before the ground freezes; water again when the trees are breaking dormancy. Thin out stands to promote good air circulation. Provide good soil drainage and avoid planting in poor sites such as heavy clay soils.
- d. Apply an appropriate fungicide. See label instruction for details on the rate and timing of the application. Spraying of isolated trees may be safely omitted if thorough eradication is practised.

Do not carry firewood on your holiday. Elm wood with bark can spread Dutch Elm Disease. Report diseased elms immediately to your district agriculture office or city parks department.

Never plant trees in low-lying areas subject to frequent summer flooding. Note along the highways of Alberta how trees thrive on the knolls and die in the hollows.

## Eradication

- A. In late fall, winter or early spring, remove and burn all cankered limbs. Where possible, make these cuts at least 30 to 45 cm back along healthy wood. Remove dying trees and known sources of infection on your property by destroying badly infected trees and pruning unhealthy or infected branches of other trees. Encourage your neighbors to do likewise. Infected elm trees will be removed immediately and burned, stumps will be chipped off to below soil level and covered over.
- B. During the growing season, cut off and destroy any infected twigs several centimetres below the infection, but avoid excessive pruning at this time. Proper disinfection of tools is necessary when pruning.
- C. Destroy alternate hosts in the vicinity of valuable evergreen plantings such as hawthorn or saskatoon shrubs that may harbor rust disease

- D. Infected bark on large surface roots and the trunk should be cut out. Do not cover with soil until the fall. This will allow a healthy callus to form.
- E. Collect and remove or compost all fallen leaves.

## Apple-Cedar Rust/ Hawthorn-Juniper Rust

Primary hosts: cedar or juniper

Secondary hosts: apple, crabapple, saskatoon, cotoneaster, pear, hawthorn, mountain ash, and other rosaceous plants.

### Description of Damage

On the primary host: symptoms consist of reddish brown galls from 3 to 50 mm in diameter on the branches. Older galls have circular depressions with small protuberances that enlarge to form gelatinous, yellow-orange "spore-horns" following rainy periods in the spring. These should be pruned out to prevent infection of the secondary host.

On secondary host: small, pale yellow spots appear on the upper surface of leaves in the spring. These gradually enlarge and turn orange. Numerous spots may occur on a single leaf and young fruits may become similarly infected. These spots may be covered with numerous spiny projections.

### Summary of Life History

Hawthorn-juniper rust is a fungal disease that requires two different host species to complete its life cycle. Both primary and secondary hosts must be growing in close proximity for the disease to develop. Spores are released from the horns on the primary host and are carried by wind to hawthorn leaves. Infected secondary hosts then produce spores that are carried back to the primary hosts to complete the life cycle.

### Eradication

- A, B, C

### Prevention

- a

## Black Knot

Plum, cherry, chokecherry and mayday

### Description of Damage

Small, light brown swellings on newer growth are the first symptoms. The knots may only reach a size of 1 to 2 cm in diameter. In the spring, knots turn olive green and have a velvety textured surface. By autumn, they turn black and harden and may be 10 to 15 cm long completely encircling the limb. The knots continue to expand during successive seasons and may eventually kill branches or sometimes the main trunk.

### Summary of Life History

Black knot is a fungus that produces spores, which are wind-blown or rain-splashed from knots to healthy branches in the spring.

### Eradication

- A, B

### Prevention

- b

### Chemical control

- Captan, sulphur

## Browning of Evergreens

Evergreens

### Description of Damage

Some needle shed is natural particularly late in the fall. Excessive defoliation may result from frost injury (sudden droop of growing tips), herbicide injury (curl, twist or distortion of new stems; whole branches with needles that are light yellow or white; green tips following severe crown discoloration), drought (trees gradually turn brown from top down and outside in), cold or winter injury (sudden deep red-discoloration of branches), salt injury via run-off or drift from highways, dog damage (browning of outer, lower branches) and iron deficiency (gradual yellowing of foliage over several years).

### Summary of Life History

Browning of evergreen needles is caused by a variety of environmental and site factors. The color change is usually definite and sometimes quite spectacular. Often the change occurs long after injury, so recovery may not be possible.

### Prevention

- c

## Canker Disease

Most trees and shrubs

### Description of Damage

Disease symptoms usually consist of dead tree tissues which crack open and expose the wood underneath. In some cankers, the healthy tissues next to the canker may increase in thickness and appear higher than the normal surface of the stem.

### Summary of Life History

Cankers can be caused by fungal or bacterial infections and/or by environmental stresses such as sun scald, frost, fire and hail. A wound is the key event in canker formation. The most common wound site is a branch stub although mechanical injuries from lawn mowers are also common sites for cankers on shade trees.

### Eradication

- A, B

### Prevention

- b, c

## Cytospora Canker

### Description of Damage

On deciduous trees, sunken elongated cankers form on the trunk or branches. The bark on the canker face is often cracked and discolored with a callus ridge at the margin. Small black pimples appear on the dead bark on the canker face. Small branches and twigs are rapidly girdled while larger branches and the main stem may take several years to become girdled. On conifers, the lowest branches are killed and then branch death progresses up the tree. Dying branches first exhibit yellow-green then purple foliage and later drop their needles. A large amount of resin flows from infected branches and coats the entire surface of the bark around the cankers and drips onto lower branches.

### Summary of Life History

The fungus overwinters on the bark and in the cankers. During wet weather in the spring, spores are formed and are washed to other branches by rain splash. These spores can also be transported by insects, pruning tools, and clothing. If the spores land on a wound, they can cause infection. Cankers develop as the fungus invades healthy bark.

Cytospora is usually found on dying or dead tissue. Fruit trees such as apples or cherries that annually produce large fruit crops become weakened and susceptible to Cytospora.

### Eradication

- A, B

### Prevention

- b, c

## Dutch Elm Disease

American elm is highly susceptible. Chinese and Siberian elms are highly resistant. At present, Dutch elm disease is not known to occur in Alberta, but it is widespread elsewhere.

### Description of Damage

The earliest symptoms on trees are yellowing and/or wilting of the leaves on a single branch usually in the upper crown. Yellow or wilted leaves quickly turn brown and die. This symptom is known as a "flag". The symptoms spread in subsequent seasons, usually one branch at a time, to progressively larger branches and eventually the entire tree.

### Summary of Life History

Dutch elm disease is caused by a fungus that overwinters in infected and recently killed elm trees, in stumps and in logs. It is carried from infected wood to healthy trees by elm bark beetles. The disease may also invade trees through root grafts from adjacent infected trees.

### Eradication

- A

### Prevention

- a, b, c

### Chemical control

- Is only recommended in other areas of Canada where Dutch Elm Disease is present such as Manitoba and Ontario.

## Fireblight

Apple, crabapple, pear, mountain ash, European cotoneaster, hawthorn, saskatoon

### Description of Damage

Infected blossoms suddenly become blighted and turn brown. Later, young shoots may appear as if scorched by fire. Leaves on infected branches often remain on the trees all summer and well into the winter. The disease also produces cankers. These cankers are discolored, slightly sunken and tend to crack at their edges. Columbian and centennial crabapples are particularly susceptible to this disease.

### Summary of Life History

Fireblight is a destructive bacterial disease. During the spring and early summer in moist, warm weather, cankers that were not removed may exude a slimy bacterial ooze. This ooze, consisting of millions of bacterial cells is spread to blossoms by insects, including honey bees. The disease may also be spread by rain, wind and pruning shears. Fireblight epidemics can develop during early summer warm periods (over 18°C) when there are alternating intervals of rain and sunshine. Diseased parts must be removed promptly.

### Eradication

- A, B

### Prevention

- a, b, c, d
- Regularly remove all water sprouts and small shoots from the inner main branches of all susceptible trees. This will greatly reduce or eliminate the chances of main branch or trunk infections by this disease.

### Chemical control

- When infections are so severe that pruning is not useful, treat the cankers with a zinc chloride solution. The solution is made by adding 6 ml of hydrochloric acid to 100 ml water, followed by 226 g zinc chloride and 340 ml methyl hydrate. This solution is painted over the infected areas and on the bark 25 to 40 cm below the edge of the canker. During the blossom and early summer period when weather is warm (18°C) and moist, spray with fixed copper [Copper Oxychloride 50 WP, Copper Spray WP Fungicide]. These treatments give protection for only 72 hours. If more rain occurs and copper has not been applied within the last 72 hours, an additional spray should be applied. Repeat sprays as necessary under warm moist conditions.
- Limitations – Preharvest interval – 1 day (copper oxychloride).

## Leaf Scorch, Yellowing and Dieback

Deciduous trees and shrubs

### Description of Damage

Symptoms include yellowing and/or darkening of tissues between leaf veins or along the leaf margins. Rapidly wilted leaves may retain a pale green color. Entire leaves may dry up, turn brown and become brittle. Damage is usually more pronounced on the upper, windward or southern side of trees. Plants may lose many leaves prematurely during late summer and exhibit some twig dieback.

### Summary of Life History

Leaf scorch is caused by adverse environmental conditions such as soil compaction, transplant shock, nutrient deficiency, drought, salt toxicity or herbicide injury.

### Prevention

- b, c

## Leaf Spots, Blotches, Shot-holes

Deciduous trees, particularly the cherry family

### Description of Damage

Symptoms range from well defined dead areas on the leaf to superficial growth of white to grey-white fungus material on leaves and shoots. Despite what appears to be extensive damage, most leaf diseases are not very damaging to shade trees. In some cases diseases that cause premature defoliation lower food reserves.

### Summary of Life History

Various species of fungi can cause leaf spots. Most remain dormant in the dead leaves during the winter. Some fungi survive in the buds or on dead twigs and branches. In the spring during wet weather, the fungi become active and discharge spores. The spores quickly penetrate the leaves and produce disease symptoms. During summer, spores cause new leaf infections during wet weather.

### Eradication

- E

### Prevention

- a, b, c, d

### Chemical control

- Copper-based fungicides

## Needle Cast

Pine, spruce, larch

### Description of Damage

Several fungi cause needle cast. Needles, when first infected, turn a light green to yellow color. Eventually the entire needle turns brown to reddish brown. Needle browning occurs in a random fashion while the current season's growth remains green. In severe cases, the only green needles remaining are those of the current year's growth.

### Summary of Life History

The disease most commonly occurs on pine trees. In July, infected needles turn a whitish straw color and tiny black fruiting bodies appear. These fruiting bodies produce spores, which are released during wet weather. They germinate and penetrate only the young developing needles. The only external evidence of the infection is a slight pale green spot, which can easily be mistaken for insect damage. The fungus overwinters on dead needles on the tree and on the ground. In the spring of the next year, the spot enlarges in size and needle browning occurs.

Spore formation and release may occur in the fall with other needle casts.

Rake up and destroy infected needles.

### Prevention

- a, c, d

### Chemical control

- Copper oxychloride or chlorothalonil in August on pine and in June for spruce and larch, when spores are being released.

## Shoot Blight of Lilac

Lilac

### Description of Damage

The symptoms seen in spring are black spots on stems and leaves of young shoots. These spots increase in size forming large blotches. Immature leaves may turn black and die along with entire shoots, which frequently curl over and wither. Flower clusters turn brown and flowers fail to develop when infected by the bacterium.

### Summary of Life History

Both a bacterium and a fungus can cause shoot blight. The bacterium overwinters in stems and branches. Disease spread occurs most rapidly during rainy periods when bacteria are splashed from infected to healthy tissue. The fungus persists in the soil.

### Eradication

- A, B

### Prevention

- a, b, c

### Chemical control

- Copper oxychloride at leaf fall and again at bud opening and stem elongation during spring.

## Shoestring Root Rot

Shoestring root rot affects a wide range of shrubs and trees that are commonly used as ornamentals.

### Description of Damage

Symptoms range from a slow gradual dieback to sudden death. Infected roots have mats of the fungus between the bark and the wood. In the late summer or early fall, honey colored mushrooms may appear around the base of infected trees. The black shrivelled remains of the mushrooms can often be found for many months. Remove infested stumps and as much of the roots as possible.

### Summary of Life History

Shoestring root rot is a fungal disease that overwinters in both living and dead trees. During the spring the fungus resumes growth through the soil and infects healthy roots of nearby trees. After the infected tree is killed, the fungus lives for many years in the soil.

### Eradication

- D

### Prevention

- c

## Silverleaf

Deciduous trees and shrubs

### Description of Damage

The most characteristic symptoms are a silvery or leaden sheen to the foliage in marked contrast to the deep green of healthy leaves on the same plant. The metallic color intensifies and rusty-looking streaks may develop along the leaf midribs. In the following season affected branches may die or produce small undersized leaves, flowers and fruit. Dry or alkaline soils may produce a form of leaf silvering that can be mistaken for silverleaf. This is the most destructive disease of mountain ash, cotoneaster and other members of the rose family. Infected trees or shrubs die in two to three years.

### Summary of Life History

Silverleaf is a fungus that produces spores during wet periods in the growing season. The spores are wind borne to healthy trees where the fungus can successfully infect the tree through major wounds to the trunk or branches. Fruiting bodies (oyster shell mushrooms) on dead branches, trunks or old stumps are the sources of new infectious spores. The fungus will not infect through shoots that may be clipped as in hedge trimming.

### Eradication

- A, B

### Prevention

- b, c
- Avoid lawnmower damage to tree trunks, and cover any trunk or branch wounds immediately as they are seen with wet soil or pruning paint. Never prune trees during the growing season from May to November.
- Wet soil is loaded with micro-organisms that prevent infection by disease causing fungi and bacteria.

## Slime Flux

Poplar, American elm, and Siberian elm are common hosts of this disease in Alberta.

### Description of Damage

Typical symptoms are wilting, branch dieback and an external or internal slime flux. Affected wood generally is dark, water-soaked and has a foul odor.

### Summary of Life History

Slime flux is caused by a bacterium. Infection usually originates in a crotch of the tree where water accumulates and does not run away. Insect and mechanical or pruning injuries provide wounds where bacteria can enter the tree.

### Eradication

- A, B

### Prevention

- b, c

## Western Gall Rust

Hard pines

### Description of Damage

This disease stimulates the stem cells to divide rapidly causing pronounced swellings. Infections generally remain localized and do not progress from branches into the main stem. Galls may persist for many years without killing branches; however, a noticeable reduction of host growth often occurs.

### Summary of Life History

This fungal disease can cause serious damage to pines. Two or three years after infection, the galls or blisters rupture, allowing powdery, yellowish-orange spores to be spread by the wind.

### Eradication

- A, B

### Prevention

- a, b

# Diseases

## OF SMALL FRUIT

Diseases can seriously damage small fruits in Alberta and growers should be aware of the damage they cause. Preventive disease control programs, including sanitation, selection of resistant varieties and proper cultural practices, should reduce or eliminate the need for chemical control. If fungicides must be used, carefully follow the manufacturer's recommendations for rates and timing of application.

Information on varieties and general growing practices for small fruits is available in the *Alberta Horticultural Guide*. Many destructive diseases of small fruits are caused by viruses. It is imperative that virus-free plants be obtained. If plants in your garden are suspected of having a virus that appears to be significantly affecting production, get rid of them. Fungal and bacterial diseases can usually be controlled quite effectively with good preventive cultural practices.

### Prevention

- a. Plant resistant varieties or use planting stock that is certified disease and virus free. Select only winter-hardy varieties. Select healthy looking plants with well developed root systems.
- b. Create optimal growing conditions by providing adequate water and fertilizer especially during the blossoming and early fruiting periods and by controlling harmful insects that may cause extensive defoliation, or transmit viruses or other diseases. Avoid unnecessary injury to plants during cultivation. Provide good soil drainage. Avoid over-fertilization and prune plantings to allow for good air circulation.
- c. Do not plant in an area that has been used for growing small fruits within the past four years.
- d. Apply a protective fungicide. See label instruction for details on rates of application. Check label for information as to which plants the pesticide can be used on, and note how many days before harvest the last spray can be made.
- e. Avoid excessive water applications during the fall hardening-off period. Avoid fertilizing, cultivating or pruning after mid-July because this stimulates succulent growth. Provide winter cover by bending raspberry canes and covering the tips with soil to hold them down.
- f. Usually not serious, control measures are seldom necessary.
- g. Plant in a protected or sheltered area with others of its kind to ensure cross-pollination.

### Eradication

- A. Prune and discard old raspberry canes or infected branches after harvest. Prune approximately 10 cm below infected areas. Remove and destroy badly infected plants. Properly and repeatedly disinfect shears with a solution such as lysol® (50 ml per litre of water), or household bleach (100 ml per litre of water). Always work on healthy looking trees and branches first.

- B. Remove and destroy leaves and plant residue after harvest.
- C. Pick and pack only sound fruit. Discard damaged fruits or store separately.

### Anthracnose

Raspberry, strawberry, and blueberry

#### Description of Damage

All above-ground plant parts may be attacked. Small, circular, slightly raised, purple spots appear on young canes in midsummer. The spots may enlarge and turn a grey color in the centre with purple margins. Some leaves may show "shot-hole" symptoms if the spots fall out. Infected green fruits fail to mature and dry up, while ripe fruits turn brown and soft.

#### Summary of Life History

Several different fungi can cause anthracnose. The fungi overwinter on diseased canes. Spores are produced in the spring and spread by rain or wind.

#### Eradication

- A, B

#### Prevention

- b, d
- Preventive fungicide: captan when new shoots are 15 to 20 cm high.

### Black Knot

Chokecherry, plum, cherry

#### Description of Damage

See Black knot under "Ornamentals".

#### Summary of Life History

See Black knot under "Ornamentals".

#### Prevention

- See Black knot under "Ornamentals".

## Black Leaf and Witches' Broom

Saskatoon

### Description of Damage

Diseased plants have extensive branch development in a small area producing a witches' broom appearance. The undersides of leaves are covered with a dense black fungus growth.

### Summary of Life History

This disease is caused by a fungus that overwinters on twigs and branches of saskatoon bushes particularly in shady locations. The fungus also survives on dead leaves on the bush and on the ground from which it infects new growth in the spring. The disease can grow into new growth, but does not grow into older wood.

### Eradication

- A, B

### Prevention

- Grow in sunny locations, avoid shade

## Black Root Rot

Strawberry

### Description of Damage

Plants with black root rot generally have much smaller root systems than normal. Main roots show patches or zones that are darker than the rest of the root. Small feeder roots may show a similar patchiness or be entirely lacking. Tips or major sections of main roots may be killed, and in cross section they show a black color throughout.

### Summary of Life History

Black root rot can be caused by a number of fungi, environmental conditions, herbicide or fertilizer burn or a combination of these. The fungi that can cause this disease can all be found in soil. They will infect and damage plants only if growing conditions are suboptimal.

### Prevention

- a, b, c

## Botrytis Grey Mold

Strawberry, raspberry, saskatoon, and chokecherry

### Description of Damage

Blossoms, blossom stalks, and green and ripe fruit may be attacked. Infection usually starts in young blossoms. Several blossoms in a cluster may turn brown, dry up and eventually the entire blossom stalk dies. Some blossom infections spread only as far as the calyx or hull where the fungus remains dormant until the fruit ripens at which time a fruit rot will occur. The fungus spreads rapidly between berries that are in direct contact in a cluster. Grey mold may not appear on ripe fruit until one or two days after picking.

### Summary of Life History

Grey mold is a fungal disease that is favored by shade and dense foliage where air circulation is poor and sustained periods of high humidity are likely to occur. Under humid conditions, an abundance of light grey spores are produced on infected plant parts. These are easily dislodged and spread by wind currents. The fungus overwinters on various types of plant residue in the soil.

### Eradication

- C

### Prevention

- a, b

### Chemical control (for strawberry and raspberry only)

- Captan and benomyl + captan  
(Preharvest interval – 7 days).

**Cane Blight**

Raspberry

**Description of Damage**

Symptoms include dark brown to purplish cankers which form at wounds (from pruning, insects, etc.) on new canes usually towards the end of the season. As the cankers enlarge and extend down the cane, lateral shoots may suddenly wilt and die. Infection, wilting and death of side branches on second-year canes may occur if wounds are present. Infected canes are brittle and snap off easily. Infected fruiting canes generally die between blossoming and fruit set.

**Summary of Life History**

The fungus overwinters on diseased canes. Spores are wind-blown, rain-splashed or carried by insects.

**Eradication**

- A

**Prevention**

- a, b

**Chemical Control**

- Sulphide sulphur at dormant or bud bursting stage, or captan when new shoots are 20 to 25 cm.

**Crown and Cane Galls**

Raspberry and many other woody and herbaceous plants

**Description of Damage**

Plants develop galls or knots the size of peas to golf balls on the roots and crown. The galls are white at first, turn brown and warty with age, and finally decay. Cane galls appear as small, warty out-growths on the sides of raspberry canes. Plants infected with cane or crown gall may or may not exhibit any reduction in vigor or fruit set.

**Summary of Life History**

This is a bacterial disease that survives for extended periods in fertile soil. The bacteria invade plants only through breaks in the bark and wounds made by insects, pruning and cultivating.

**Eradication**

- A

**Prevention**

- a, b, c

**Fireblight**

Raspberry

**Description of Damage**

Blossoms die, fruit set is poor with lots of dead blossoms, and yields are much lower than expected. Young canes suddenly turn black from the tips down, and leaves brown and curl and remain on infected canes.

**Summary of Life History**

This bacterial disease is almost identical to fireblight of apples and pears, but this strain of bacterium is thought to be restricted to raspberries. The raspberry cultivar Boyne may be particularly susceptible, whereas Honey Queen appears to be resistant.

See fireblight under "Ornamentals".

**Eradication**

- A

**Prevention**

- a, b, c

**Inadequate Pollination**

All small fruits

**Description of Damage**

In the absence of insects, berries tend to be small and are frequently malformed. Stamens of primary flowers may not form well during the cool weather of early spring, thereby creating a shortage of pollen. In such cases, large numbers of pollinating insects are needed to insure a good fruit set. The careless application of insecticides during blooming could seriously reduce populations of pollinating insects.

**Summary of Life History**

Maximum yields and fruit size are achieved when abundant pollinating insects are present. On cool windy days pollinating insects do not fly. On cold or windy days pollinating insects may only be active in areas protected by shelterbelts or buildings.

**Prevention**

- g

## Juniper Rust

Saskatoon

### Description of Damage

See Apple-cedar rust/Hawthorn-juniper rust under "Ornamentals".

### Summary of Life History

See Apple-cedar rust/Hawthorn-juniper rust under "Ornamentals".

### Prevention

- See Apple-cedar rust/Hawthorn-juniper rust under "Ornamentals".

## Leaf Spots

Strawberry

### Description of Damage

Symptoms vary depending on which fungus is responsible. In general, they consist of spots of damaged or destroyed areas of the leaves. These spots can enlarge and cause leaves to have a scorched appearance. Fruits and fruit stems may also be affected.

### Summary of Life History

Leaf spots are caused by several different fungi. These fungi produce spores in the spring that are carried by wind and rain to healthy foliage. Leaf spot diseases are often brought into a field when new plants are set out. The fungi overwinter on live and dead leaf tissue. Moist warm weather favors the development of leaf spots.

### Eradication

- A

### Prevention

- a, b

## Mummy Berry and Brown Rot

Saskatoon, blueberry, chokecherry

### Description of Damage

Infected twigs and flower clusters suddenly darken and wilt. Infected tissues generally exhibit a felty brown mass of fungal growth (spores) during humid periods. Infected berries turn tan to salmon in color and are small and wrinkled.

### Summary of Life History

This fungus infects twigs and flowers. Dead infected berries (mummies) usually cling to the trees after the foliage and other berries have fallen. Wind and rain splashing are the major means by which the spores are spread to healthy tissues.

### Eradication

- A, B, C

## Poor Drainage

All small fruits

### Description of Damage

Roots fail to develop and plants become weak. Root rot diseases may follow and plants are very susceptible to winter kill.

### Summary of Life History

Root rot results when soils are very wet for prolonged periods of time or are planted in depressions with poor drainage.

### Prevention

- b
- Never plant in low lying wet areas subject to flooding. These same areas are also much more prone to late spring and early fall frosts.

## Powdery Mildew

Strawberry, raspberry, currant (red, white, black, albol) and gooseberry

### Description of Damage

Infected leaves are distorted, turn purple and curl upwards exposing undersides, which are coated with a dusty, white fungal growth. Severely affected leaves may wither, and die.

The disease can be severe on currants and gooseberries. Under shaded or semi-shaded conditions, the disease can cause severe stunting or death of European gooseberry and black currant cultivars. On black currants with mildew resistance, the disease can break dormancy in buds that would normally form next season's flowers. The disease is of minor consequence on strawberries and raspberries.

### Summary of Life History

Powdery mildew is a fungal disease that often appears shortly before fruiting. Warm, dry weather accentuates the symptoms of powdery mildew. The fungus spreads by air-borne spores. It overwinters on diseased leaf litter. Good mildew resistance is available in red currants and gooseberries.

### Cultural

- Avoid shaded or partially shaded locations. Prune to maintain open currant and gooseberry growth form and remove weak or crowded branches.
- **Resistant cultivars:** White currants – *White Grape, Large White, White Imperial*;  
Small-fruited American gooseberries – *Pixwell*;  
Albol currants variously referred to as Missouri, California, or cross currants;  
Black currants – *Ben Nevis, Black Dawn, Brod Torp, Jet*
- **Intermediate resistance:** Albol currants, red currants – *Large Knight, Red Lake, Red Cross, Perfection*;  
Black currants – *Willoughby, Ben Lomand, Boskoop, Tsema*.

**Susceptible:** All European gooseberries and red currants and many North American and European black currants.

### Eradication

- B

### Prevention

- a, b, g, h, i, k
- Bicarbonate of soda (baking soda) at 2 ml per litre of water sprayed onto the foliage has been repeatedly reported in many parts of the world to give good control of powdery mildews.

### Chemical control

- Apply sulphide sulphur at delayed dormant (green tip) stage. At prebloom, full bloom and early fruit set apply sulphur. Omit full bloom spray for currants. Some varieties are sulphur sensitive.
- Preharvest interval – 1 day (sulphide sulphur, sulphur).

## Spur Blight

Raspberry

### Description of Damage

Weakened plants often have a reduced yield and may winterkill. Purplish to chocolate brown spots and bands appear on young canes directly below the points where the leaves are attached. The diseased areas often enlarge and girdle stems, and may spread to buds, petioles and leaves. Leaves may fall prematurely especially on lower portions of the plant. Infected bark may dry out and crack by late summer.

### Summary of Life History

This fungal disease is a common and damaging disease of red raspberries. The fungus survives from season to season on infected plant parts. Spores are produced during wet periods and spread by wind or rain. Infection occurs through healthy or wounded tissue.

Avoid thick plantings and excessive rates of nitrogen fertilizer. Prune out surplus canes during the growing season and old canes after harvest.

### Eradication

- A

### Prevention

- a, b, d
- Preventive fungicide: sulphide sulphur at the delayed dormant or bud bursting stage.

## Sunscald

All small fruits

### Description of Damage

Exposed surfaces become discolored at first then later turn to greyish-white patches.

### Summary of Life History

This problem often develops on ripening fruit during hot sunny weather.

### Prevention

- b

## Viruses

All small fruit

### Description of Damage

Leaf mottling, yellowing, vein banding and crinkled leaves are characteristic symptoms of virus diseases that can infect small fruit.

### Summary of Life History

There are many different viruses that infect small fruits. Although different viruses produce different symptoms, the control of all viruses is basically the same. Once a plant is infected by a virus, the virus cannot be eliminated. Viruses can be introduced with the plant stock or by insects such as aphids and leafhoppers, which transmit viruses. Destroy virus infected canes as they appear on raspberries.

### Prevention

- a, b

### Eradication

- A

## Winter Injury

All small fruits

### Description of Damage

Winter injury can be a severe problem in certain chinook areas. Fruiting canes usually produce blossoms but berries fail to develop or may dry up before ripening. Canes may die after leafing out. Tip dieback frequently occurs.

### Summary of Life History

Winter injury resulting from root injury occurs most commonly during winters of little snowfall. Damage usually occurs when temperatures fluctuate excessively or rapidly. Winter kill may also take place as a consequence of unusually cold weather that occurs during some winters.

### Prevention

- a, e
- Raspberry canes and particularly black raspberry, grapes and blueberries can be pegged to the ground in early November and covered with a few inches of coarse peat moss, soil or straw. This will allow them to overwinter successfully. If straw or peat moss is used, check for mouse damage.

### Fairy Ring

#### Description of Damage

Fairy rings are circles or semi-circles of dead or dark green grass in the turf. Tan-colored mushrooms often appear during wet periods in the summer and autumn on the outer edges of affected areas. The soil beneath the fairy ring is infested with masses of white "threads" of fungus. Fairy rings enlarge as they grow older. A ring may take two to three years to become visible. The area of fungal infection is in the form of a "thin doughnut" in the thatch under the turf.

#### Summary of Life History

This fungus is found on all kinds of turf, including highly maintained greens-type turf and pastures. Fairy rings are common in all lawns and are most distinctive on dry underfertilized turf. The fungus feeds on the old thatch just above the soil surface. Damage results from the mycelium infested thatch forming an impenetrable barrier to water penetration to the turf roots above the infested area.

#### Cultural

- Damage can be masked with fertilizer applications or by aerating the ring thoroughly with a garden fork and watering heavily and frequently. To eradicate the ring, the ring and infested soil up to 30 cm from the outer edges of the ring must be completely dug out to a depth of 15 cm.

#### Chemical

- No effective chemical controls exist despite claims to the contrary.

### Powdery Mildew

#### Description of Damage

Grass blades become coated with a grey or white powder. Leaves may turn yellow, orange or brown. Mildew occurs all through the growing season but is not usually severe until autumn.

#### Summary of Life History

Mildew is most common in shaded areas of lawns (e.g., under trees and on north sides of buildings). New seedlings of some Kentucky blue grass cultivars in sunny locations may be damaged. Excessive or deficient nitrogen favors the disease.

#### Cultural

- Use the more shade-tolerant creeping red rescue, instead of Kentucky blue grass in shaded areas. Raise the height of cut in shaded areas and do not apply excessive amounts of nitrogen. Cultivars that show little powdery mildew are "Dormie", "Nugget" and "Sydsport".

### Slime Molds

#### Description of Damage

Patches develop in the lawn where leaf blades are coated with clusters of tiny "beads" that are sticky and lilac-grey. The appearance is similar to patches of spilled oil. Little damage is done to the grass.

#### Summary of Life History

Prolonged periods of wet weather pre-dispose the turf to this problem. Then fungi live in the soil and reproduce during rainy periods.

#### Cultural

- Patches can be removed by sweeping or mowing when turf dries.

#### Chemical

- None required.

### Snow Molds

(pink snow mold, grey snow mold, snow scald, cottony snow mold)

#### Description of Damage

There are four types of snow mold diseases in Alberta. The disease-causing fungi grow at low temperatures such as during cold, wet autumn and spring weather and under the snow in winter. As snow melts, patches of grey, white or pink fuzzy mold appear on the grass. The grass blades may turn yellow or brown; circular to irregular patches or turf may die and eventually form large areas of dead grass.

#### Summary of Life History

Turf is most at risk when snow falls on unfrozen, wet ground. Heavy snow accumulation that lasts late into spring allows the disease a long time to develop. Excessive nitrogen fertilizer forces the turf to grow late into autumn, so the turf does not "harden-off" for winter and is more susceptible to snow mold.

#### Cultural

- Reduce fertilizing and irrigation in late summer to allow the turf to harden-off. Rake up fallen leaves. Break up piles of snow to speed their melting in spring. Pick up grass clippings. When the turf has dried in spring, use a stiff broom to break up the patches of mold.

# Vertebrate Pests

## Ground Squirrels

Ground squirrels will occasionally move into lawns and gardens in midsummer. They will dig a burrow system with an entrance 5 to 6 cm in diameter. The simplest method of removing ground squirrels is to fill the burrow with water from a garden hose. You can then dispatch the squirrels when they emerge from the burrow. If you do not want to kill the squirrels, re-flooding the burrow will cause the squirrels to move elsewhere.

Ground squirrels can also be poisoned within urban areas with a prepared bait containing 0.005% chlorophacinone or diphacinone. Place about one tablespoon or 15 ml of bait within each ground squirrel hole. After 48 hours, re-bait all holes where the bait has been disturbed or removed. Remove and bury all dead squirrels. You may have to bait a third time for complete control.

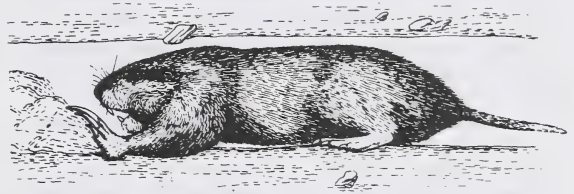
Use leghold or live-capture traps to remove squirrels occupying structures such as staircases, patios, garages, etc. Set traps in a manner so as not to capture non-target animals. Set traps at or near the point of access and use food bait (peanut butter) for live-capture traps only. Cover leghold traps with dirt and anchor solidly to the ground. Inform neighbors of your trapping or set traps during the day only and check them every few hours.



## Pocket Gophers

Pocket gophers, also called "moles", eat garden crops and kill woody plants and shrubs by feeding on the roots. They also deface lawns with the mounds of soil that are deposit of soil excavated from rodent runways. Gophers plug the vertical tunnel beneath the mound, and it is here where gopher traps such as the Convert, Black Hole and Guardian Pocket Gopher perform well. Pocket gopher traps can catch gopher quickly and are safe to use because they are set

underground. Gopher runways run parallel to the ground surface and are located 2 to 20 cm below ground level. Locate the burrow with a long screw driver or probe. Begin to probe 1 to 2 cm from the edge of the mound. The burrow will be up-slope from the mounds and at the base of fan-shaped mounds or in the indentation of horseshoe-shaped mounds. Carefully follow instructions as directed by the trap label.



## Mice and Rabbits

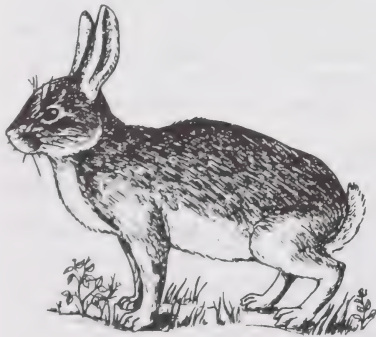
Mice and rabbits will occasionally girdle trees and shrubs during the winter. A number of ready-made taste repellents discourage rabbits and mice from feeding on trees. Apply repellents in late fall when the leaves have fallen and the bark is dry. The temperature should be above freezing and the repellent should cover the trunk of the tree, 0.6 to 1 m above the snow line. Repellents are only effective when animals have other sources of food. If mice and rabbits are hungry and have nothing else to eat, repellents may be ineffective.

Fences and tree guards tend to be more effective than repellents but are also more expensive and time consuming to construct. You can use three guards when only a few trees are involved. Make guards from 0.65 cm (1/4 inch) wire screen set 7 to 10 cm into the ground. Guards should reach a height of 0.6 to 1 m above the snow line. Garden crops can also be protected by covering young plants with wire mesh, hardware cloth or used plastic strawberry containers. Invert strawberry containers and cone-shaped pieces of wire mesh or hardware cloth over young plants until the plants become established.

Mice can eat grass and create runways and bare patches on lawns. This damage to turf occurs in winter beneath the snow. It is too late to do anything about the mice after the damage is discovered in the spring. Blue grass lawns can recover although the grass may be thin the first summer. Quackgrass may invade bare patches. If quackgrass is present, overseed bare patches in May or June, cover with about 1 cm of soil and water frequently until seedling grass emerges. Keep your lawn neatly mowed and remove long grass and vegetation from adjacent areas to reduce the chances of mouse damage. Where mouse damage occurs repeatedly, pack the first 10 to 15 cm of snowfall by walking

over the area. The hard packed snow may prevent the mice from gaining access to the area.

Mice can best be removed from homes and out buildings with traps. If mice are a continuing problem, seal all holes and cracks wider than 6 mm (1/4 inch) with concrete mortar, galvanized sheet metal, heavy-gauge hardware cloth or other material that will resist rodent gnawing. Mobile homes and garages present special problems because they frequently have openings that cannot be plugged to prevent entry by mice. Place mouse bait at six to eight different locations beneath a mobile home and at three or four different places in a two-car garage, no more than 2.5 to 3 m apart. Protect bait from children and pets by placing bait in a commercial or home-made enclosed bait station, 20 to 25 cm long and 5 to 7.5 cm wide with a 2 to 5 cm opening at both ends. Make bait stations with pipe, scrap wood, plywood or sheeting, which will keep bait dry and free from dust. Secure bait stations and check daily for bait replenishment and mouse removal. Bait stations can also be made from a 15 x 45 cm board nailed at a 45 degree angle where the floor and wall meet. Place about 50 g of anticoagulant bait in each bait station. There are several anticoagulant poisons that are acceptable for mice. These include chlorophacinone, diphacinone, bromadiolone and brodifacoum. Inspect bait frequently to ensure that it is fresh, dry and free of mold.



### Yellow-bellied Sap Sucker

This bird is a member of the woodpecker family. Sap suckers drill horizontal rows of squarish holes through the bark of primarily spruce, Scots pine, birch and Siberian elm. Sap suckers feed on sap and sap wood. Humming birds, will feed on this sap and like the sap sucker take advantage of the insects attracted to the sweet ooze. Girdled trees may die. Because these birds are a protected species it is unlawful to kill them, so wrap the damaged areas of trees in burlap and treat with pruning paint. Use noise makers to scare birds away.

### Bats

Bats are beneficial insect-eating animals, but they can be a nuisance in attics or unoccupied buildings. One or two bats in a house is a frequent problem. A bat usually will find a way out by detecting fresh air movement. The simplest solution is to open all windows and doors leading outside. If the bat is still present at nightfall, turn off the lights to help it find open doors or windows.

The only long-term solution for ridding an attic of bats is to seal up all cracks and openings larger than 6 mm (1/4 inch). Ensure that bats are not sealed within the house. The best time to start is in the fall after young bats have learned to fly and before the onset of cold weather.

You can sometimes remove bats from an attic with repellents. Place naphthalene crystals on trays, paper plates or in loose-meshed bags suspended from the rafters. About 2.3 kg for every 60 m<sup>3</sup> (2,000 cu. ft) will treat an average attic. Lights can also be an effective repellent. Large attics may require four or more 100-watt bulbs, but a 150-watt spot light is more effective. Drafts can repel bats where it is possible to open doors or windows and create strong breezes with an electric fan.

Bats can carry rabies. Always vaccinate your dogs and cats. Do not touch bats or else handle them only with gloves. People who are bitten or scratched by a bat should see their doctor. When exposure of people or pets has occurred, capture the bats and place them in a jar or box so that they can be tested for rabies. Contact the public health department or a veterinarian for details on where to submit a bat for a rabies test.

If you have properly identified your pest problem and determined that cultural practices will not be sufficient to control the insect, weed or disease, you may decide to use a pesticide.



# Safe Use of Pesticides

## Before Purchasing Any Pesticide

- Read the product label to make sure that the pesticide will control the pest that you have and can be used on the plant you are trying to protect.
- Spray at the proper time for effective control. Before spraying fruits and vegetables, check the pre-harvest intervals listed on the label to determine when to harvest your produce. Some pesticides have pre-harvest intervals of several weeks.
- Choose a pesticide that is compatible with your application equipment. If you do not have and do not wish to purchase the appropriate equipment, contact a commercial pesticide application company.

## What is on the Pesticide Label?

The label is the result of years of research and development. The statements on the label must be reviewed and approved by Agriculture and Agri-Food Canada, Health and Welfare Canada, Environment Canada and Fisheries and Oceans Canada before the product can be sold.

The instructions on the label are like a prescription; they tell you how much pesticide to mix, how to apply it, when to apply it, where to apply it, and precautions to be observed. The label also tells you of specific organisms to be protected – bees, fish and so forth. You must be aware of sensitive areas to be protected from pesticide drift. Reread the label each time before using a pesticide. Do not rely on your memory.

The pesticide label is a tool, learn to use it.

## Protect Yourself When Applying Pesticides

- Mix pesticides outdoors or in well-ventilated areas only.
- Skin protection is essential. Always wear long pants, a long-sleeved shirt, neoprene gloves (not plastic), waterproof boots and a waterproof hat when mixing or applying pesticides as spray solutions.
- Wash skin thoroughly with soap and water after handling pesticides.
- Launder clothing worn to apply pesticides separately from other clothing. Wash the clothes in hot water with a heavy-duty laundry detergent. Hang clothing outdoors to dry.

For further information on pesticides, contact any regional office of the Pesticide Management Branch:

|                |          |
|----------------|----------|
| Edmonton       | 427-5855 |
| Lethbridge     | 381-5511 |
| Calgary        | 297-8262 |
| Grande Prairie | 538-5460 |

## Be a Responsible Pesticide User

You are responsible for ensuring that pesticides used on your property do not present a hazard to your family or neighbors. Drifting insecticides can present a health hazard and drift from herbicides can damage gardens and flower beds. Many weed killers can also be absorbed by tree roots. If neighbors have tall trees, make sure the weed killer you are using will not be absorbed by these trees (roots of large trees can extend a considerable distance).

- Advise neighbors that you will be spraying so they can close windows and doors if they wish. Some people are very sensitive to chemical sprays.
- Remove toys from the area being treated, and cover or remove lawn furniture if there is any chance of pesticide contamination.
- Do not spray on days when wind speeds are over 16 kph. Ideal wind conditions occur with a gentle breeze, 5 to 10 kph, blowing in a uniform direction away from neighboring yards or sensitive vegetation. When using weed killers on your lawn, leave an unsprayed "buffer" strip around trees, vegetable gardens and flower beds.
- Spray on warm days (20 to 27°C). A pesticide application when the temperature is over 30°C is less effective because plants will absorb less pesticide and the pesticide droplets will vaporize.
- Keep children and pets away from the treatment area until pesticide exposure can be minimized: 48 hours for lawns treated with herbicides (24 hours after watering or rain) and four hours after spraying trees and shrubs with insecticides (lawns can be watered to remove insecticide residues that may have dripped onto grass).
- If you are hiring a company to perform weed or other pest control applications for you, make sure the company has a pesticide service approval issued by Alberta Environmental Protection and that all applications are performed or supervised by a certified applicator.

## Storage

Do not purchase more pesticide than you will require. This will help you avoid storage and disposal problems. When you do have a pesticide that you will be using several times during the growing season, take precautions to make sure it is stored where accidental spills or poisoning is unlikely.

- Avoid storing pesticides in your home, especially if you have young children. If you must store these products in your home, keep them in a separate, locked cupboard.
- To avoid spills, store pesticides on lower shelves in a cool, dry area that will not be subject to freezing. Do not store pesticides on a high shelf in an effort to keep the chemicals away from children – this only encourages accidental spills (a good lock will keep children away

from harm). Keep pesticides in their original container so you will always have a label reference in case of a spill or poisoning emergency.

- Store containers of liquid pesticide inside transparent plastic bags to reduce contamination should a spill occur.
- If a spill does occur, ventilate the contaminated area (open windows and doors) and absorb the pesticide with pet litter, newspaper, or paper towels. Use neoprene gloves to collect the absorbed pesticide, and dispose in plastic garbage bags. Wash the contaminated area several times with a bleach/detergent mix, and keep the area well ventilated until all fumes have disappeared. If fumes persist after four hours, contact Alberta Environmental Protection at 1-800-222-6514 for further assistance.
- In case of accidental poisoning, contact the Provincial Poison Centre at 1-800-332-1414.

### Pesticide Container Disposal

Add a small quantity of water (200 to 500 ml) to empty pesticide containers and swirl to rinse. Add rinse water to spray solution to make up part of total water volume required to bring pesticide concentrate to desired dilution. Rinse the container twice more. Wrap triple rinsed container in newspaper and dispose with household garbage.

### Disposal of Pesticide Concentrate

Excess adulterated or otherwise unwanted pesticide concentrate can be disposed of, free of charge, at Toxic Roundups scheduled once or twice per year. Paints, pesticides, cleaners and other toxic wastes should be taken to municipal sanitation or waste management departments during Toxic Roundup periods. For information on the schedule for your area and the programs, call the Alberta Special Waste Management Corporation at 1-800-272-8873.

## How to Reduce Your Exposure to Pesticides

Because chemical pesticides are so widely used in our society, and because of the properties of many of the chemicals, low levels of pesticide residues are found throughout the environment. Pesticides reach us in a variety of ways – through food, water and air.

In regulating pesticide use, the federal government strives to ensure that lawful use of these products will not result in harmful exposure. Proper use of registered products should yield residue levels that are well within established safety standards. Therefore, the average person's exposure to low-level residues should not cause alarm.

Still, many people want to learn what choices they have to further reduce the potential risks associated with pesticides. By limiting your exposure to pesticides, you can keep your risks to a minimum. If, however, you suspect that you suffer from serious chemical sensitivities, consult an expert to develop a more personally tailored approach to managing this problem.

### Home-grown Food

Growing some of your own food can be both a pleasurable activity and a way to reduce your exposure to pesticide residues in food. But, even here, there are some things you may want to do to assure that exposure is limited.

- Before converting land in an urban or suburban area to gardening, find out how the land was used previously. Choose a site that had limited (or no) chemical applications and where drift or run-off from your neighbor's property will not result in unintended pesticide residues on your produce. Choose a garden site strategically to avoid these potential routes of entry.
- Do not add soil or manure to your garden unless you are certain that no unwanted pesticide residues are present. Herbicide residues may persist for many years preventing the growth of many garden plants.
- Select seeds and seedlings from hardy, disease-resistant varieties. The resulting plants are less likely to need pesticides to flourish.
- Alternate rows of different kinds of plants to prevent significant pest problems from developing.
- Rotate your crops yearly to reduce plant susceptibility to over-wintered pests.
- Become familiar with integrated pest management techniques, so that you can manage any pest outbreaks that do occur without relying solely on pesticides.
- Mulch your garden with leaves, hay, grass clippings, shredded/chipped bark. Avoid using newspapers to keep down weeds and sewage sludge to fertilize plants. Newsprint may contain heavy metals; sludge may contain heavy metals and pesticides. Both can leach into soil.
- When using pesticides on fruits and vegetables, be sure to observe the minimum "pre-harvest" intervals stated on labels. A pre-harvest interval tells you how long you must wait to eat a food product after it has been treated with a particular pesticide at a particular rate.
- Always follow pesticide label directions carefully to make sure that you are not over-dosing food products. If label rates have been exceeded, a safe pre-harvest interval cannot be guaranteed.

## Safety and First Aid

### Pesticides are Poisons

The potential for a pesticide to cause injury depends upon several factors:

#### Toxicity of the active ingredient

Toxicity is a measure of the inherent ability of a chemical to produce injury. Some pesticides, such as pyrethrins, have low human toxicity while others, such as strychnine, are extremely toxic.

#### Dose

The greater the dose of pesticide, that is, the amount absorbed, the greater the risk of injury. Dose is dependent upon the absolute amount of the pesticide absorbed relative to the weight of the person. Therefore, small amounts of pesticide might produce illness in a small child, while the same dose in an adult might be relatively harmless.

#### Route of absorption

Swallowing a pesticide or inhalation of pesticide droplets usually create the most serious problem. In practice, however, the most common route of absorption of pesticides is through the skin. The more toxic pesticides have caused fatalities through this route.

#### Duration of exposure

The longer a person is exposed to pesticides, the higher the level in the body. However, there is a point at which an equilibrium will develop between the intake and the output or breakdown of the poison. Then, the level will no longer continue to increase.

### Recognizing Pesticide Poisoning

External irritants may cause contact associated skin disease primarily of an irritant nature - producing redness, itching, or pimples or an allergic skin reaction, producing redness, swelling, or blistering. The mucous membranes of the eyes, nose, mouth and throat are also quite sensitive to chemicals. Stinging and swelling can occur.

Internal injuries from any chemical may occur, depending upon where a chemical is transported in the body. Thus, symptoms are dependent upon the organ involved. Shortness of breath, clear sputum production or rapid breathing occur as the result of lung injury. Nausea, vomiting, abdominal cramps or diarrhea may result from direct injury to the gastrointestinal tract. Excessive fatigue, sleepiness, headache, muscle twitching and loss of sensation may result from injury to the nervous system. In general, different classes of pesticides produce different sets of symptoms.

For example, organophosphate pesticides may affect several different organs and produce symptoms of pesticide

poisoning that progress rapidly from very mild to severe. Symptoms may progress in a matter of minutes from slight difficulty with vision to paralysis of the diaphragm muscle, causing inability to breathe.

Therefore, if someone develops symptoms after working with pesticides, seek medical help promptly to determine if the symptoms are pesticide-related. In certain cases, blood or urine can be collected for analysis, or other specific exposure tests can be made. It is better to be too cautious than too late.

It is always important to avoid problems by minimizing your exposure when mixing and applying pesticides by wearing gloves and other protective clothing.

### First Aid for Pesticide Poisoning

#### If the Victim is Not Breathing

Administer mouth-to-mouth artificial respiration until adequate breathing has been restored. Be sure to clean any contamination from the victim's face before administering artificial respiration. Call an ambulance or take the victim to the nearest hospital emergency ward.

#### If the Victim is Breathing but Unconscious

Remove contaminated clothing taking care to avoid contaminating yourself and wash contaminated skin. Position the victim in a semi-prone position turned slightly to one side. This will prevent choking should vomiting occur. DO NOT GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Call an ambulance or take the victim to the nearest hospital emergency ward.

#### If the Victim is Breathing and Conscious

Remove contaminated clothing and wash contaminated skin thoroughly with soap and water. (If possible, skin should be washed with continuous running water for at least 10 minutes).

- Find the pesticide label and bring it to the telephone.
- Phone the Poison Control Centre (1-800-332-1414) and provide them with: an assessment of victim's breathing; the exact name of the pesticide as it appears on the product label; circumstances of the exposure (fumes, spray drift, spill, etc.); symptoms; what action has been taken; the name and age of the victim; and the phone number of where you are calling from or where you are taking the victim to.

If further medical attention is required, the Poison Control Centre will telephone your local hospital to prepare them for your arrival. If hospitalization is required, the Poison Control Centre will organize transport. If a hospital visit is not required, the Poison Control Centre will provide first aid advice and follow-up calls every hour for four hours to ensure that full recovery has been achieved.

If you are unable to contact the Poison Control Centre, follow first aid instructions listed on the pesticide label and

contact the Poison Control Centre as soon as possible. DO NOT INDUCE VOMITING UNLESS RECOMMENDED ON THE PESTICIDE LABEL.

**If a Pesticide has been Splashed into the Eyes**

Immediately bathe the eye in a gentle stream of clean water and continue for at least 15 minutes. Report to the nearest hospital emergency ward.

**In Case of Emergency Call the Poison Centre 1-800-332-1414**

This is the 24 hour, toll-free telephone number for the provincial Poison Centre. Calgary residents may dial 670-1414.



# ATTENTION HOMEOWNERS

## Hiring someone for weed or pest control?

Before you hire someone to spray for weed or pest problems, be sure the company has a Pesticide Service Approval issued by Alberta Environmental Protection and that applications are performed or supervised by a certified applicator. Weed and insect control chemicals can be hazardous if they are not used properly. Don't put yourself or your neighbors at risk by hiring someone who may not be qualified.

For further information regarding pesticide applicator certification or Service Approval verification, please contact the nearest office of Alberta Environmental Protection.

|                |          |
|----------------|----------|
| Edmonton       | 427-5855 |
| Calgary        | 297-8262 |
| Lethbridge     | 381-5511 |
| Grande Prairie | 538-5460 |

**Alberta**  
ENVIRONMENTAL PROTECTION

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Potato Flea Beetle  
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Raspberry Fruitworm  
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